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(54) Self-cleaning litter box for animals

(57) A self-cleaning litter box (20) for cats employs a comb drive (41, 55, 57) to drive a comb (43) through litter to remove waste from the litter. A sensor (400) for detecting the presence of an obstruction is coupled to the comb drive (41, 55, 57) and stops the comb drive upon detecting an obstruction. A manual mode selector switch (91) and an actuating switch (370) are provided to manually activate the cleaning of the litter box at a time deemed appropriate by the cat owner. A foot pedal unit (372) may be provided for semi-automatic use. A removable tray (300) for cat litter may be provided. The tray (300) may be disposable. A pivotable ramp (350) facilitates ingress to, and egress from, the litter box (20). The ramp (350) may be carpeted. A tray (500) receives the litter box (21) and a hood (548) encloses the litter box (20) to provide privacy.

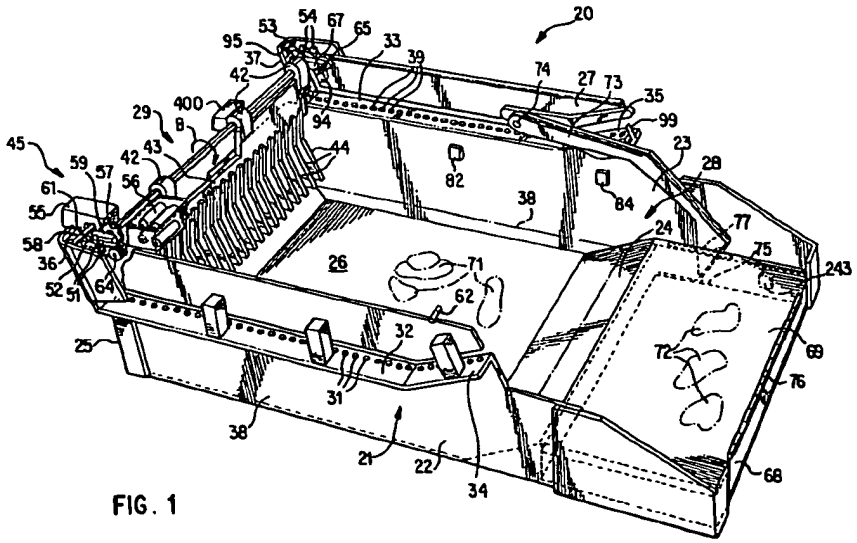

FIG. 1

EP 0 972 442 A1

Description

[0001] The present invention is directed to litter boxes and particularly to self-cleaning litter boxes for cats.

[0002] Cats are usually trained to use a litter box for elimination of both liquid and solid wastes. A cat litter box is normally made of plastic or like material so that a cat's urine will not leak through the box. Other cat litter boxes have been proposed, as in the construction described in U.S. Patent No. 5,249,549 (Rockaitis), in which the litter box is made of a material that absorbs liquid but does not permit it to leach through to the exterior of the box. The litter used in boxes of this kind may be one of any number of particulate litter or other materials that absorb moisture from the waste of the cat. The material may also suppress odor from cat waste. Some forms of cat litter form clumps when wet. Usually, a cat will bury its solid waste in the litter material in the box.

[0003] Most cat owners take appropriate action to discard the litter from a cat litter box after an appreciable period of time, often several days. On the other hand, even before the litter has been thoroughly saturated with waste from the cat or cats that use it, a cat may be inclined to push some of the litter out of the box, particularly if the odor is strong. In any event, the person using a cat litter box may find the task of emptying the cat litter to be unpleasant. Thus, a number of devices have been proposed for cleaning cat litter boxes. Such devices are disclosed in U.S. Patent Nos. 4,096,827 (Cotter), 4,117,804 (Moore et al.), 4,190,525 (Menzel), 4,325,325 (Larter), 4,325,822 (Miller), 5,048,465 (Carlisi), 5,226,388 (McDaniel), and 5,477,812 (Waters).

[0004] The self-cleaning cat litter box disclosed in the Carlisi patent utilizes a rake or comb that is normally maintained in a storage position at one end of the litter chamber. At predetermined intervals the comb is moved through the litter, from the rake storage end of the chamber to the opposite end, which constitutes a discharge end for the chamber. At the discharge end of the chamber, the rake moves up out of the litter and discharges any clumps collected by the comb into a disposal receptacle. Unfortunately, because cats are not consistent in their elimination habits, such periodic cleaning may be too frequent or not frequent enough.

[0005] The Waters patent describes a system for moving a comb or rake through the litter responsive to entry and exit of the cat from the litter box. In addition, Waters provides an improved disposal receptacle and alarms to report an insufficient litter supply and a full disposal receptacle. The entire disclosure of the Waters '812 patent is incorporated herein by reference.

[0006] Despite the advances made by these prior art patents, there remains several deficiencies in self-cleaning litter boxes. First, if the cat is present in the litter box while the rake or comb is moving, the cat may be startled to move suddenly and spill the contents of the litter box, or the cat could be caught by the mechanism. Second, devices that require the passage of time or the activity of a cat to initiate the rake drive mechanism do not allow for use of the rake at other times. Third, easy access is needed to aid cats in entering and exiting the litter box. The open boxes allow litter to be spilled out and do not provide cover for cats that may desire privacy.

[0007] The present invention alleviates to a great extent the deficiencies of the prior art by providing a litter box having a housing defining an upwardly open litter chamber for receiving cat litter, a comb disposed in the litter chamber, a carriage supporting the comb, and a comb drive for driving the comb between a storage position and a discharge position. The comb drive includes a reversible drive motor mounted on the carriage. A reverse sensor is coupled to the carriage. The reverse sensor is coupled to a first surface of the carriage and the sensor provides a shut-off signal to the comb drive when the sensor detects that the carriage has contacted a cat or other obstruction while moving between the storage position and the discharge position. According to one aspect of the invention, the reverse sensor includes a switch electronically coupled to the drive motor for providing the shut-off signal to the comb drive in the closed position. In one embodiment of the invention, the reverse sensor is a leaf switch.

[0008] In another aspect of the invention, the litter box has a mode selector switch. The switch may have a manual operation selecting position and an automatic operation selecting position. In addition, a manual operation switch may be electrically connected to the mode selector switch. According to another aspect of the invention, the comb drive drives the comb between a storage position and a discharge position in response to actuation of the manual operation switch when the mode selector switch is in the manual operation selecting position.

[0009] In yet another embodiment of the invention, a rectangular tray has side walls and a bottom wall that cooperate to define a housing-receiving region. Hood supports are coupled to the rectangular tray. A hood is coupled to the supports. The hood includes an opening for a cat to enter or exit the litter box. According to another aspect of the invention, a housing access ramp is pivotally connected to the housing, preferably at the opening.

[0010] In still another embodiment of the invention, the litter chamber includes a removable litter tray for receiving the cat litter.

[0011] The present invention may also be provided with means for ensuring that the comb stops when it strikes a cat while moving between the storage and discharge positions. By stopping the comb, the situation in which a cat is pinned between the comb and a wall is prevented.

[0012] The invention provides a manual cleaning mode that allows the cat owner to initiate the waste removal upon the activation of a switch. This mechanism would allow the cat owner to clean the waste out of

the litter box at a time deemed appropriate by the cat owner.

[0013] The invention also provides an enclosure for a self-cleaning litter box to provide privacy for the cat. The enclosure could also be used to prevent litter from being spilled out of the box.

[0014] Other features and advantages of the present invention will be readily apparent from the following description and drawings which illustrate preferred embodiments of the invention.

FIG. 1 is a perspective view of an automated self-cleaning litter box for use by a cat, constructed in accordance with a preferred embodiment of the invention, showing the litter box in a waiting condition with the comb at the storage position. The dress panels have been removed for clarity to expose the internal structure.

FIG. 2 is a perspective view of the litter box of FIG. 1 in an intermediate condition with the comb traversing the litter box between the storage position and the discharge position.

FIG. 3 is a perspective view of the litter box of FIG. 1 in a discharge condition with the comb in the discharge position.

FIG. 4 is a transverse sectional view taken along line 4-4 of FIG. 2 and includes the dress panels.

FIG. 5 is a side view, partially broken away, of another litter box constructed in accordance with the invention.

FIG. 6 is a plan view of the litter box of FIG. 5.

FIG. 7 is an end view, as seen from the storage end, of the litter box of FIG.5.

FIG. 8 is a front view of a locking tab and a locking projection, according to a preferred embodiment of the present invention, for retaining a removable litter tray in the litter box of FIG. 5.

FIG. 9 is a partially broken away side view of the locking tab of FIG. 8 engaging a locking notch formed on the locking projection.

FIG. 10 is a partially broken away side view of the locking tab of FIG. 8, illustrating the locking tab in a depressed position to disengage the locking tab from the locking notch.

FIG. 11 is a top view of a rotating tray lock for retaining the removable tray in the litter box of FIG. 5.

FIG. 12 is a side view of the rotating tray lock of FIG. 11.

FIG. 13 illustrates the rotating lock of FIG. 11 in an unlocking position.

FIG. 14 illustrates the rotating lock of FIG. 11 in a locking position.

FIG. 15 is a partial section view along line 15-15 of FIG. 13, through the litter box and removable tray of FIG. 5, illustrating a rotating tray lock in relation to the litter box and removable tray.

FIGS. 16-18 are partial perspective views illustrating the sequence of removing a removable litter tray from the litter box of FIG. 5.

FIG. 19 illustrates a reverse sensing leaf switch, according to a preferred embodiment of the present invention, in an open-circuit configuration.

FIG. 20 illustrates the leaf switch of FIG. 19 in a closed-circuit configuration.

FIG. 21 is a block diagram of the drive and control for the litter box of FIG. 5.

FIG. 22 is a side view of the self-cleaning litter box of FIG. 5, including a manual operation foot switch.

FIG. 23 is a flow chart for operation of the cat litter box of FIG. 5.

FIG. 24 is a flow chart illustrating optional modes of operation for the controls of the automated self-cleaning cat litter box of FIG. 5.

FIG. 25 is a perspective view illustrating a hood supporting structure, according to a preferred embodiment of the invention, including a tray and hood supports.

FIG. 26 illustrates the tray of FIG. 25 with a hood disposed over the hood supports.

FIG. 27 illustrates an end portion of a hood support of FIG. 25 engaging an opening formed in a sidewall of the tray; and

FIG. 28 illustrates a self-cleaning litter box disposed in the tray of FIG. 25.

[0015] FIGS. 1-4 illustrate a self-cleaning litter box 20 that includes a comb 43 that rakes clumps of litter 71 into a waste receptacle 68. Comb 43 moves from a storage position, shown in FIG. 1, to a discharge position, shown in FIG. 3. As comb 43 approaches the discharge position, lid 69 of waste receptacle 68 opens to allow

clumps of litter 71 to enter the receptacle. After dumping the clumps of litter 71 into receptacle 71, comb 43 automatically reverses direction to return to the storage position. Sensor 400, shown schematically in FIGS. 1-4, detects the presence of a cat or other obstruction and automatically stops the comb and reverses its direction of travel.

[0016] FIGS. 1-4 illustrate a litter box 20 having a pan-shaped housing 21. Housing 21 has a near side wall 22, a far side wall 23, and a discharge end wall 24 joining side walls 22, 23 at one end of litter box 20. Litter box 20 also has a comb storage end wall 25 connecting side walls 22, 23 at the other end of litter box 20. The bottom of litter box 20 is identified by reference numeral 26. The fill level to which box 20 is usually filled with cat litter is shown by litter level line 38 (dashed line). Litter level line 38 may be afforded by a continuous or interrupted ridge in the interior of housing 21. Thus, litter box 20 has a discharge end 28 at one end and a comb storage end 29 at the opposite end. Side walls 22, 23, end walls 24, 25 and bottom 26 to box 20 are preferably formed in a molding operation that produces complete housing 21.

[0017] A comb shaft 41 extends across the litter box 20 between two side tracks 32, 33. There are four hangers 42 journaled on and depending from shaft 41. Three of hangers 42 appear in FIGS. 1-3. The fourth hanger 42 can be seen in FIG. 4. A comb or rake 43 is suspended from hangers 42 and includes a plurality of tines 44. In FIG. 1, which illustrates a waiting or storage condition, comb 43 is located at comb storage end 29 of litter box 20, and tines 44 are elevated above litter fill level 38. In FIG. 2, which illustrates an intermediate condition, comb 43 is traversing litter box 20 from storage end 29 to discharge end 28, and the lower ends of tines 44 project down into the litter in box 20, close to bottom 26 of box 20, also shown in FIG. 4. In FIG. 3, comb 43 is shown near the end of its raking stroke at discharge end 28 of litter box 20. At discharge end 28 of litter box 20, tines 44 of comb 43 again move upwardly out of the litter.

[0018] An elongated near side track or path member 32 extends along the top of near side wall 22 of housing 21. Track member 32 includes a multiplicity of equally spaced apertures 31. Apertures 31 extend through an inclined portion 34 of rack 32 at discharge end 28 of litter box 20; they also extend through a more steeply inclined portion 36 of rack 32 at comb storage end 29 of litter box 20. This track construction is repeated on the opposite side of housing 21. Thus, an elongated track member 33 projects horizontally from vertical side wall 23. Track member 33 includes a multiplicity of equally spaced apertures or perforations 39. The pattern of apertures extends along an inclined portion 35 of track member 33 at discharge end 28 of litter box 20. It also extends along a more steeply inclined portion 37 of track 33 located at comb storage end 29 of litter box 20.

[0019] A first main guide wheel 52 is affixed to the near end of shaft 41. Guide wheel 52 includes a plurality of radially projecting guide pins or teeth 51 engageable in apertures 31 of track member 32 and its extensions 34 and 36. At the other end of shaft 41, there is a similar main guide wheel 53. Radial projections 54 on guide wheel 53 are engageable in apertures 39 of track member 33 and its extensions 35 and 37. Guide wheels 52 and 53 cause the ends of shaft 41 to move along tracks 32 and 33, based on rotation of shaft 41, from the storage position of FIG. 1 through the intermediate position of FIG. 2 to the discharge position of FIG. 3 and back to the FIG. 1 storage position.

[0020] In addition to main guide wheels 52, 53 referred to above, the drive and guidance system of litter box 20 includes two auxiliary guide wheels 64, 65, located on the near and far sides of litter box 20, respectively, as seen in FIGS. 1-3. Auxiliary guide wheel 64 is mounted at the end of a lever 66 that projects from one of hangers 42 used to suspend comb 43 from shaft 41. Auxiliary guide wheel 64 rides along track 32 throughout the length of that track, including its upwardly inclined end sections 34 and 36. Similarly, auxiliary guide wheel 65 is mounted on a lever 67 and engages the other track member 33 and its extensions 35, 37 (FIG. 4).

[0021] FIG. 5 illustrates an alternative track 231. In particular, track 231 includes an upper surface 235 spaced apart from a lower surface 237 and a plurality of teeth 239 depending from upper surface 235. A guide wheel 253 for use with track 231 includes a plurality of cogs 254 for engaging teeth 239. A secondary hub 241 extends outwardly toward the side walls from wheel 253 and is sized to cooperate with lower surface 237 to prevent cogs 254 from disengaging from teeth 239. Advantageously, the use of teeth 239 depending from the upper surface 235 avoids the possibility of litter becoming lodged between teeth 239 and blocking movement of wheel 253.

[0022] The improved self-cleaning cat litter box 20, FIGS. 1-3, includes a comb drive that comprises a reversible electric motor 55 mounted on and connected in driving relationship to shaft 41 that supports comb 43; the final gear 57 of the gear train that connects motor 55 to shaft 41 is the only gear that appears in the drawings. Motor 55 is energized by batteries contained in a battery case 56. Motor 55 and the gear train represented by gear 57, as well as battery case 56, are supported by shaft 41; in conjunction with the shaft, they constitute the carriage 45 for comb 43 in litter box 20. A reversing switch 58 is mounted on and is electrically connected to motor 55. A lever 59 is mechanically connected to reversing switch 58. Lever 59 has a limited pivotal movement from the position shown in FIG. 1 to the position illustrated in FIG. 2. A first switch actuation pin 61 is located adjacent comb storage end 29 of litter box 20. A similar fixed switch actuation pin 62 is positioned at the other end, discharge end 28, of litter box 20.

[0023] A waste receptacle 68 is positioned immediately adjacent to discharge end 28 of litter box 20. In FIGS. 1 and 2, waste clumps 71 are indicated in the lit-

ter chamber; similar clumps 72 are shown in FIGS. 1-3 as being already deposited in receptacle 68. Receptacle 68 has a hinged lid 69 and a pair of indentations 63, 70 (FIG. 6). The indentations 63, 70 are formed in the bottom of receptacle 68 and receive bosses 222, 223 (FIG. 29). Bosses 222, 223 retain waste receptacle 68 in position within litter box 20. Waste receptacle 68 and its lid 69 are preferably formed of a biodegradable material. Moreover, receptacle 68 should be transparent; alternatively, lid 69 may be transparent, or, of course, both may be transparent enough to permit the user to visually check the level of waste and litter in receptacle 68. Lid 69 is engaged by pin 75 on lid lift lever 73 that is pivotally secured to a vertical extension 27 of side wall 23. The pivotal connection is indicated at 74. There need be no comparable lid lift mechanism 73-75 at the near side of the machine, though one could be provided if motor 55 and battery case 56 were mounted closer to the center of the litter box.

[0024] Waste receptacle 68 may be formed of plastic or other suitable material. Lid 69 for receptacle 68 is hinged to the receptacle as indicated at 76. A hinge of the so-called "piano" type may be used, but other hinge structures are acceptable. Lid 69 may also be formed of plastic. On the other hand, receptacle 68 and its lid 69 may be fabricated of other appropriate material. Preferably, receptacle 68 initially serves as a container for clean litter so that, once the receptacle 68 is ready to be discarded, it can simply be removed and a new receptacle 68 put in place after emptying clean litter from the new waste receptacle 68 into the chamber afforded by housing 21.

[0025] A sensor may be used to determine whether or not the receptacle is full. In the embodiment of FIGS. 1-3, sensor 243, preferably a photodetector, is mounted on side wall 23 at a level indicative of a full receptacle. An appropriate light source 242 is mounted on side wall 22 opposite photodetector 243. When the litter level rises in the receptacle to block the light from source 242, photodetector sounds an alarm, such as a buzzer, to alert the user.

[0026] Another sensor may be utilized to sense the exit of a cat from the litter chamber afforded by housing 21. In the embodiment of FIGS. 1-3, there are two such sensors 82, 84, both mounted on wall 23 above litter fill line 38. Devices 82 and 84 may comprise conventional photo detectors, each receiving a light beam from a source (not shown). FIG. 4 shows an appropriate light source 86 mounted on wall 22 above fill level 38. Photodetector 82 (FIG. 4) is also located above fill level 38. A single light source located centrally along the length of wall 22 can be used or there may be two such light sources 86, one for each of the photo detectors 82, 84.

[0027] As shown in FIGS. 5-7, a removable litter tray 300 is disposed in the litter box 20 adjacent to bottom 26. Tray 300 includes handle portion 306 and tray portion 304. Tray portion 304 is filled with litter to fill line 38 as discussed above. Tray portion 304 includes distal end 305 and proximal end 307 and is designed to slide through an opening 301 of storage end wall 25. Side walls 22, 23 of housing 21 may contain rails, detent projections or other mechanisms (not shown) to ensure the sliding engagement of tray portion 304 in litter box bottom 326. Tray portion 304 is slid through storage end wall 25 until distal end 305 of tray portion 304 comes into contact with discharge end wall 24. When tray portion 304 comes into contact with discharge end wall 24, handle portion 306 of removable litter tray 300 extends through storage end wall 25. In preferred embodiments, the corners and edges of housing 21 and removable tray 300 are rounded to facilitate cleaning as illustrated, for example, in FIGS. 4 and 7. Preferably, apparatus 200 has no nooks, crannies or other small spaces of the type that would permit litter or waste to slip out of or become lodged in apparatus 200.

[0028] Other features are also illustrated in FIGS. 5-6. In particular, an alternative lilt mechanism 174 includes lift plate 173, connected to litter box 20 by hinge 176, and a pair of end walls 175, 177 disposed orthogonally to the plane of lift plate 173. Each end wall 175, 177 includes a camming edge 179 operatively disposed to engage carriage 45 as the carriage moves to the discharge position. Preferably, lilt plate 173 includes a plurality of apertures 181 for receiving complementary tabs 183 formed on lid 69 of receptacle 68. Tabs 183 fit in apertures 181 with a friction fit to connect lid 69 to lilt plate 173. Thus, as carriage 45 approaches the discharge position, it engages camming edges 179 and pivots lilt plate 173 about hinge 176 to open waste receptacle 68. The friction fit of tabs 183 in lilt plate 173 allows lid 69 to be easily removed from lift plate 173 to be disposed of with a full waste receptacle 68.

[0029] As shown in FIGS. 5 and 6, apparatus 200 also has parallel side walls 201 on opposite lateral sides. Side walls 201 may be formed of a suitable plastic material. Side walls 201 have top edges 202 extending from the back to the front of apparatus 200. Side walls 201 help prevent cat litter or other debris from being spilled out of apparatus 200.

[0030] As illustrated in FIGS. 8-10, handle portion 306 includes resilient locking tab 302 formed therein. Locking projection 320 extends downwardly from outside surface 325 of comb storage end wall 25 to distal end 326. Locking projection 320 includes front wall 322 and a pair of side walls 324 extending from the edges of front wall 322 to define a U-shaped channel. The distal end of front wall 322 includes semicircular opening 327 (FIG. 8), and the distal end of each sidewall 324 includes notch 328, (FIGS. 9-10). Notches 328 are disposed to engage locking tab 302 when tray portion 304 is completely slid into housing 21.

[0031] When litter tray 300 is disposed in litter box 20, locking tab 302 engages notches 328 to retain tray 300 in litter box 20. To remove tray 300, a user inserts a finger into semicircular opening 327 and depresses resilient locking tab 302, causing tab 302 to disengage from

notches 328. Although locking projection 320 and locking tab 302 have been illustrated, it will be appreciated that other latching mechanisms can be used. Locking tab 302 is preferred, however, because it is easy to operate and is readily formed integrally with the removable tray during the molding process.

[0032] In addition to locking tab 302, litter box 20 includes a pair of tray locks 330, illustrated in FIGS. 11-15, disposed on discharge end wall 24. As shown in FIGS. 11-12, each tray lock 330 includes locking disk 333 and shaft 335 that projects from the bottom surface of disk 333 and is offset from the center of the disk. Shafts 335 include groove 337 for receiving circlip 338. Shafts 335 are sized to extend through apertures 339 formed in discharge end wall 224 with disks 333 cooperating with circlip 330 to retain tray locks 330 in position. Thus, tray locks 330 are rotatably connected to discharge end wall 224. Apertures 339 are located on end wall 224 so that the offset portion of disk 333 rotates between an unlocking position (FIG. 13), wherein removable tray 304 is released for removal, and a locking position (FIG. 14). In the locking position, a portion of disk 333 overlaps distal end 305 of the removable tray to prevent removal, as illustrated in phantom in FIG. 15. Tray locks 330 can be adapted to have grooves 341. Grooves 341 would be used to allow tool 334, such as a screwdriver or a coin, to lock and unlock tray locks 330. Other indicia 343 may be added to indicate whether tray locks 300 are in the locking or unlocking position.

[0033] As illustrated in FIG. 15, removable tray 300 preferably includes beveled edge 345 formed on distal end 305, and discharge end wall 224 includes beveled step 347 formed to be complementary to beveled edge 345. Beveled edge 345 and step 347 cooperate to provide a seam that resists litter intrusion.

[0034] To remove litter tray 300, as illustrated in FIGS. 16-18, a user inserts tool 334 into tray locks 330 to rotate tray locks 330 in direction 332 (FIG. 16) to the unlocking position. Of course, different tray locks 330 can be used. For example, a sliding tray lock could be used. Once both tray locks 330 are in the unlocking position, the user may depress locking tab 302 (FIG. 17) to disengage tab 302 from locking projection 320. Once disengaged, tray 300 may be removed from litter box 20 by pulling on handle portion 306 in direction 336 (FIG. 18).

[0035] In the preferred embodiment of the present invention, as shown schematically in FIGS. 1-3 and in detail in FIGS. 19-20, reverse sensor 400 is coupled to a back side of carriage 45 to avoid injury to a cat in the event that the carriage makes contact with the cat during movement toward the storage position. It will be appreciated that a forward sensor can be used to avoid injury to a cat if carriage 45 contacts the cat during movement toward the discharge position. Reverse sensor 400 includes reverse sensing bar 402, actuating bar 408, and leaf switch 410. Leaf switch 410 is connected to carriage 45 at a point adjacent actuating to bar 408. Reverse sensing bar 408 is held in a flexible relationship with carriage 45 by first and second bar holders 404, 406 molded therein (FIG. 6). Bar holders 404, 406 contain springs (not shown) to provide this flexible relationship.

[0036] Referring to FIG. 19, leaf switch 410 includes base 420, flexible leaf switch arm 426, rigid leaf switch arm 422 and leaf switch arm separator 424. Separator 424 prevents contacts 423, 425 from inadvertently making contact. Leaf switch arms 422, 426 have leaf switch contacts 423, 425. Leaf switch arms 427, 429 may also include leaf switch contact protectors 427, 429, respectively, to prevent damage to contacts 423, 425.

[0037] When carriage 45 contacts a cat or other obstruction, a force is applied to reverse sensing bar 402, and the force is transmitted to flexible leaf switch arm 426 by actuating bar 408. Actuating bar 408 pushes leaf switch arm 422 to bend arm 422 around leaf switch arm separator 424, causing leaf switch contact 425 to touch contact 423. Leaf switch 410 is closed, and an electrical connection is maintained, while contacts 423, 425 are in contact with each other. When leaf switch 410 is closed, a signal is generated to stop and reverse motor 55 (described below).

[0038] Leaf switch 410 is resiliently biased toward its open position (that is, contacts 423, 425 are biased away from each other). Leaf switch 410 will be closed (as described above) when sensing bar 402 contacts end wall 25 and contact 425 of flexible leaf switch arm 426 is forced into contact with contact 423 of rigid leaf switch arm 422.

[0039] Referring now to FIG. 21, motor 55 is energized from battery 56 through pre-programmed microprocessor control 96. Although not shown in FIG. 21, a conventional electrical power supply may alternatively be used to energize motor 55. Control 96 receives input signals from single space sensors 82, 84. Additional inputs to control 96 may be supplied by mode select switch 91, motor stall sensor 92, battery voltage sensor 93, home position sensor 94 for comb 43, reverse sensor 400, and manual operation switch 370.

[0040] Mode select switch 91 (FIG. 5) is a thee position switch. Mode select switch 91 is switchable between an automatic operation selecting position, a manual operation selecting position and an off position. Mode select switch 91 allows a user to decide how litter box 20 is to operate (manually, automatically, or not at all). No power is supplied to litter box 20 when mode select switch 91 is in the off position. Mode select switch 91 provides an automatic operation input and a manual operation input to control 96. In the off modes no input is generated because all components, including control 96, will not be functioning.

[0041] Motor stall sensor 92 determines whether the motor 55 is stalled. If motor 55 is started by control 96 but becomes stalled, motor stall sensor 92 will supply a motor stall input to control 96.

[0042] Battery voltage sensor 93 determines whether there is a low battery voltage condition. If there is a low battery voltage condition, battery voltage sensor 93 supplies a low battery voltage condition input to control 96. Control 96 sends a signal to sound buzzer 97 when the low voltage input is received.

[0043] Home position sensor 94 for comb 43 determines whether comb 43 has reached the "home" position. If comb 43 has reached the "home" position, home position sensor 94 supplies a "home" position input to control 96. In response to the home position input, control 96 stops motor 55.

[0044] A manual operation foot switch 370 (FIG. 22) allows a user to initiate manual operation of litter box 20 by closing switch 370 if mode selector switch 91 is in the manual position. When switch 370 is closed, a manual operation switch activated input is sent to control 96.

[0045] Limit switches 95, 99 may be provided at storage end 28 and at discharge end 29 of litter box 20. One or more buzzers or other alarm devices 97 are included in the circuit so that the cat owner can be signaled when litter box 20 is functional or when other conditions occur, such as an insufficient litter supply in box 20 or full waste receptacle 68 or low battery voltage.

[0046] If desired, apparatus 200 may be provided with a shut-off timer system (not illustrated). The shut-off timer system may be used to disable operation of apparatus 200 for a predetermined period of time, for example, six hours. Thus, for example, apparatus 200 may be disabled during the middle of the night so that apparatus 200 does not disturb resting persons or other pets. A push button over-ride system (not illustrated) may be provided to manually initiate a raking operation when apparatus 200 is otherwise disabled by the shut-off timer system.

[0047] Motor stall sensor 92, battery voltage sensor 93, buzzer 97, and leaf switch 410 of reverse sensor 400 may all be packaged in the same housing with motor 55. Such packaging would be particularly advantageous by eliminating the need for long wiring runs.

[0048] Mode selector switch 91, home position sensor 94, limit switches 95, 99 and manual operation switch 370 can be incorporated in litter box 20 in appropriate positions as desired. Home position sensor 94 may be coupled to or adjacent to the "home" position. For example, if the "home" position is determined to be storage end 29, then sensor 94 should be located adjacent to storage end wall 25. Limit switch 95 can be positioned to be actuated by any part of comb 43 or carriage 45. Limit switch 95 is disposed at storage end 28 of litter box 20 and is activated when comb 43 or carriage 45 reaches storage end 28 of litter box 20. Limit switch 99 is disposed at discharge end 29 of litter box 20 and is activated when comb 43 or carriage 45 reaches discharge end 29 of litter box 20. Manual operation switch 370 can be positioned adjacent mode select switch 91, carriage 45 or any other desired location on litter box 20.

[0049] In operation, comb 43 may initially be located at comb storage end 29. In this condition, comb shaft 41 is elevated, guide wheels 52, 53 having ridden up extensions 36, 37 of tracks 32, 33. Switch 58 and lever 59 have engaged pin 61; motor 55 is shut off but is set for forward movement. Removable tray 300 is filled with litter, approximately to level 38. Photo detectors 82 and 84 receive light beams from sources 86 on near wall 22 of the litter box (FIGS. 4 and 23). With no cat present in litter box 20, reception of the light beams by photo detectors 82 and 84 is unimpeded. All other mechanisms are in the positions shown in FIG. 1. Lid 69 is closed over receptacle 68. Receptacle lid 69 is engaged by pin 75 at the end of lever 73 but remains closed because lid opening lever 73 is inactive.

[0050] At this juncture, it may be assumed that a cat (not illustrated) enters litter box 20 for the purpose of elimination of either liquid or solid waste. With some kinds of litter, the urine from the cat creates a clump in the litter with which the bottom portion of housing 21 is filled. For solid elimination, the clump is formed by the waste itself. In either instance, the cat is likely to bury the waste or to cover it with other litter, especially with respect to solid waste. Thus, clumps 71 are produced by the cat, and those clumps are located at some level in the litter above the bottom of removable tray 300 (FIG. 23). It is assumed that box 20 has previously been used and that previously deposited waste clumps 72 are already present in waste receptacle 68.

[0051] While the cat is present in litter box 20, the light beam to at least one of the photo detectors 82 and 84 is cut off. Usually, both light beams are blocked. However, this does not initiate a self-cleaning operation in litter box 20. Subsequently, when the cat leaves litter box 20, the light beam or beams again impinge upon the photo detectors. Accordingly, an output signal from one or both cat sensors is supplied to control 96 (FIG. 21). At this point however, there still is no actuation of a self-cleaning operation in box 20 by comb 43. The reason for the delay is that the cat might return to the litter box, deciding that its elimination activities have not been completed. In these circumstances, the light beams to one or both of photo detectors 82, 84 are again cut off and the preset delay interval for actuation of a self-cleaning operation is not completed.

[0052] Ultimately, the cat leaves litter box 20 for an interval long enough to exceed the preset time delay that is set into control 96. That time interval is subject to substantial variation; a range of two to seven minutes is usually desirable. The sell-cleaning operation carried out by comb 43 should not be initiated while the cat is in the immediate vicinity because it is undesirable to cause the cat to have reason to be afraid of litter box 20.

[0053] In a preferred embodiment the operation of self-cleaning litter box 20 can be also be performed manually. Instead of waiting for the predetermined delay period, as previously described, cleaning of litter box 20 may be initiated by the cat owner. Manual operation can be achieved by placing mode select switch 91 (FIG. 5)

into a manual operation selecting position. With mode select switch 91 in this position, inputs from photo detectors 82, 84 do not initiate the preset delay feature previously described. Instead, control 96 looks for an input from manual operation switch 370.

[0054] FIG. 22 illustrates the use of foot switch 372 as manual operation switch 370. Foot switch 372 is a normally open switch providing no input to control 96 when open. Foot switch 372 is closed and thus activated when a cat owner steps on it. The closing of foot switch 372 provides an input to control 96 causing comb 43 to rake the litter (described below). This may be desirable when the cat owner wants to remove the waste from litter box 20 at a time he or she deems appropriate.

[0055] After the cat has left litter box 20 for a time exceeding the preset delay interval in control 96 (automatic operation) or after manual operation switch 370 has been activated (in manual mode), motor 55 is energized from battery 56, or a conventional power supply (not shown), through control 96. As a consequence, gear 57 and shaft 41 are rotated in the direction of arrow B in FIG. 1. The initial movement of comb carriage 45 (shaft 41, motor 55, and battery housing 56) is downwardly along track extensions 36 and 37. In the course of this downward movement of comb 43, its tines 44 are pushed downwardly into the litter in the bottom portion of housing 21, well below fill line 38. The bottoms of tines 44, when this movement is completed, are quite close to the bottom of removable tray 300, but preferably do not quite engage the bottom.

[0056] Motor 55 remains energized and shaft 41 continues to rotate in the direction of arrow B. As a consequence, comb 43 is driven across the litter chamber, from storage end 29 to discharge end 28, as indicated in FIG. 2 by arrow A. Reference may also be made to FIG. 4 where the position of the comb and its tines 44 are illustrated. As the comb moves across litter box 20 in the direction of arrow A, tines 44 engage any clumps 71 present in the litter, whether generated by the elimination of liquid or solid wastes by the cat. Comb 43 carries clumps 71 toward discharge position 28 at the far end of box 20, that is, to the right hand end of litter box 20 as seen in FIGS. 1 and 2. Comb 43 remains in a substantially erect position as shown in FIG. 2. It is prevented from rotating in the direction of arrow B by the engagement of auxiliary guide wheels 64, 65 with tracks 32, 33, respectively. The forward motion of comb 43 in the direction of arrow A is effected by rotation of shaft 41 in the direction of arrow B and the engagement of guide wheels 52 and 53 and their pins 51 and 54 in apertures 31 and 39 of two tracks 32 and 33 that define the comb path.

[0057] Ultimately, comb 43 advances to a position where its main guide wheels 52 and 53 reach the upwardly inclined extension portions 34 and 35 of tracks 32 and 33, respectively. Motor 55 is still energized; as a consequence, carriage 45 moves up the ramps or track extensions 34 and 35 to the position shown in FIG. 3. During this upward movement of comb 43, lever 73 is engaged by comb carriage 45 and is pivoted upwardly from the original position shown in FIGS. 1 and 2 to the elevated position shown in FIG. 3. As a consequence due to the engagement of pin 75 with a slot or like guide 77 in receptacle cover 69, cover 69 is moved to the open position shown in FIG. 3. When comb 43 reaches the discharge position shown in FIG. 3, additional clumps 71 are discharged into receptacle 68 to join clumps 72 already present there.

[0058] When comb 43 reaches the position of FIG. 3, it actuates limit switch 99. The resulting output signal to control 96 (FIG. 21) reverses motor 55, and motor 55 starts to rotate shaft 41 in the direction of arrow C, FIG. 3. Accordingly, comb 43 is driven by motor 55 back to its storage position illustrated in FIG. 1. In the process, discharge lever 73 is disengaged and drops back down to its original position so that lid 69 on receptacle 68 again closes. The waste from litter box 20 is now totally enclosed in waste receptacle 68.

[0059] When comb 43 has finished its movement back to a point closely adjacent to storage end wall 25, its two main guide wheels 52 and 53 encounter the steeply inclined upward extensions 36, 37 of tracks 32, 33. Motor 55 remains energized and pulls comb 43 and its shaft 41 up to the position shown in FIG. 1. When comb 43 reaches that position, switch 58 is actuated by pin 61 and sets motor 55 for subsequent operation in the forward direction. When comb 43 reaches the end of its travel, at the position shown in FIG. 1, comb limit switch 95 (FIG. 21) is actuated, and a signal is supplied to control 96 to shut off the motor. A "home" sensor 94 may be provided for the same purpose. Usually, it is desirable to have both home sensor 94 and limit switch 95 (see FIG. 21) to actuate control 96 and make sure that motor 55 is shut off with comb 43 at storage position 29 shown in FIG. 1.

[0060] In a preferred embodiment, reverse sensor 400 (FIGS. 6 and 19-20) is utilized to make sure that motor 55 is stopped and reversed when comb 43 strikes an object while returning to storage position 29. Reverse sensor 400 is normally open and does not provide an input to control 96 while open. Reverse sensor 400 is closed when reverse sensing bar 402 strikes an object forcing actuating bar 408 to close leaf switch 410. When reverse sensor 400 is closed, an input is sent to control 96 indicating that motor 55 should be stopped and reversed, and that movement of comb 43 should be stopped and reversed.

[0061] FIG. 23 is a flow chart illustrating a subroutine programmed into control 96 (FIG. 21) for a self-cleaning operation in improved litter box 20. The flow chart starts with a command to comb litter 101 supplied to control 96. As a consequence, a set direction and start command is supplied to motor 55 in stage 102 of the subroutine. In the next stage 103, if motor 55 is stalled, that condition is sensed and an output command is received by motor 55 (stage 105) to reverse the direction of motor

55. Ordinarily, however, motor 55 will not be stalled, and the next step (stage 104) is to determine whether comb 43 is at its end of travel. If not, the subroutine returns to stage 103 and checks for stalled motor 55. If comb 43 is located at the discharge end of its travel, an output signal is applied to reverse motor 55 (step 105).

[0062] When motor 55 has been reversed, the condition of motor 55 is again checked to see if it is stalled. If so, there is an output signal to stop motor 55 (step 108). Ordinarily, however, motor 55 will not be stalled and an enabling signal is received (stage 107) to check and see whether comb 43 is in its "home" position. When comb 43 reaches its "home" position, at storage end 29 of litter box 20, there is an output signal sent to stop motor 55 (stage 108) which directs the subroutine to return to the beginning of the subroutine (stage 109). If comb 43 has not reached the "home" position, the subroutine proceeds to stage 107A to determine if reverse sensor 400 has been activated. If reverse sensor 400 has not been activated, the subroutine returns to stage 106 and checks for stalled motor 55. If reverse sensor 400 has been activated, there is an output signal (stage 107A) to a stop motor (stage 108). The subroutine then returns to the beginning (stage 109). This completes the subroutine of FIG. 23.

[0063] FIG. 24 illustrates a further subroutine that is also programmed into processor control 96 (FIG. 21). The subroutine starts with power-on stage 111 that may be initiated by an appropriate switch (for example, mode select switch 91). Alternatively, the subroutine may start with insertion of appropriate batteries into battery case 55 (FIGS. 1-3) or by plugging in a conventional power supply (not shown). The next stage 112 in the subroutine is initialization of control 96. In the next subroutine stage 113, control 96 checks to determine whether mode select switch 91 of FIG. 21 is set for manual mode.

[0064] If the manual operation mode is selected, control 96 checks to determine if manual operation switch 370 (FIG. 22) has been activated (stage 113A). Manual operation switch 370 is normally open and provides a NO signal (stage 113A) when open. Manual operation switch 370 is activated by the cat owner. When manual operation switch 370 has been activated, a comb litter procedure is initiated (stage 114). If manual operation switch 370 has not been activated, the subroutine returns to mode check at stage 113.

[0065] If the program is not set for manual mode, the subroutine checks for a low battery condition (stage 115). If a low battery voltage condition is ascertained, the subroutine checks to see if the alarm mode is set (stage 116) and, if the alarm mode is set, the subroutine actuates an alarm (stage 117) to produce a programmed output from buzzer 97 (FIG. 21) that alerts the user that a change of batteries is required. Outputs generated in stages 116 and 117 may be fed back to stage 113 in this subroutine in appropriate circumstances. If a conventional power supply is used to energize motor 55, control 96 may be programmed to skip stages 115 to 117. Ordinarily, however, when the voltages of the batteries are adequate, there is a NO output and the subroutine continues by checking for a full septic or waste receptacle 68 (stage 118). Ordinarily, receptacle 68 will not be full. If receptacle 68 is full, the subroutine returns to stage 113.

[0066] In normal circumstances, with adequate room in receptacle 68, the subroutine checks to see if any septic is present (stage 119). If septic is present, the subroutine checks to determine if comb 43 is in the "home" position (stage 121). If comb 43 is in the home position, the subroutine checks for the presence of a cat in the litter box (stage 122). If the comb is not in the home position, or if the cat is not present in the litter box, the subroutine returns to the mode check (stage 113) and begins again. If the cat is present in the litter box, the subroutine waits for the delay time to expire (stage 123) and then executes a comb litter command (stage 124) and returns to the mode check (stage 113) and begins again.

[0067] Thus, the automated self-cleaning litter box 20 may be arranged so as not to frighten or disturb a cat; the self-cleaning movement of comb 43 may not occur until there is a reasonable certainty that a cat using litter box 20 has been gone for two to seven minutes, depending on the delay set into control 96, before motor 55 is energized. Other sensors can be used instead of photo detectors 82 and 94. For example, infra-red sensors receiving radiation from an appropriate infra-red source, or a strain gauge on pan bottom 26, may serve the same purpose as the photo detectors of FIGS. 1-4.

[0068] Gear drive 57 that connects motor 55 to shaft 41 is not subject to fouling by the litter, which often includes powdery material that is likely to interfere with operation of other drive mechanisms such as a worn drive. Motor 55 should be sealed against dust and dirt since it must operate in an adverse environment. Litter box 20 is simple and economical in construction, but should afford an extended operating life with little or no attention apart from periodic replacement of the litter and replacement of batteries 56.

[0069] In a preferred embodiment of the present invention, as shown in FIGS. 5 and 6, durable ramp 350 is pivotally connected to housing 21. Ramp 350 includes carpeting 352 and first and second pivot pins 354, 356 molded to one end of ramp 350. Carpeting 352 is mounted upon a top side of ramp 350. Carpeting 352 is ribbed and made of a fabric that will trap litter and provide suitable paw-cleaning and scratching-post functions for a cat utilizing ramp 350. Ribbed carpet 352 traps Litter. Carpet 352 may be easily removed for cleaning.

[0070] In order for ramp 350 to be connected to housing 21, two side walls 22, 23 may include first and second pivot holes 360, 362 at discharge end 28 of litter box 20. Ramp 350 is attached to housing 21 by placing first pivot pin 354 and second pivot pin 356 into pivot

holes formed in side walls 22, 23 of litter box 20. Carpeting 352 is facing up as depicted in FIG. 6 and will minimize litter tracking when the cat exits litter box 20.

[0071] Another feature of a preferred embodiment of the present invention, as shown in FIGS. 25-28, includes rectangular tray 500 having first and second side walls 504, 508, end wall 506 connected between side walls 504, 508, and bottom wall 502. First and second side walls 504, 508, end wall 506 and bottom wall 502 cooperate to form housing-receiving region 540. Tray 500 may be thermal formed or molded and is designed such that housing 21 may be placed within housing-receiving region 540. One aspect of tray 500 is that it can be used as a catch-all if any litter or waste is kicked out of self-cleaning litter box 20 by a cat.

[0072] Another aspect of tray 500 is that it may be used to cooperate with dome or hood 548 to define enclosure 550 for self-cleaning litter box 20. Dome 548 may be used to provide privacy for the cat. Enclosure 550 includes a plurality of hood supports 530. Hood supports 530 may be metal or plastic strips. Each hood support 530 has a first end portion 532 and a second end portion 534. To accommodate hood supports 530, first and second side walls 504, 508 have a plurality side of wall openings 510. Openings 510 are adapted to receive hood support end portions 532, 534.

[0073] Hood supports 530 are placed into side wall openings 510 such that end portions 532, 534 are retained therein by the resiliency of hood supports 530 acting against side walls 504, 508. Hood 548 is placed over hood supports 530 forming enclosure 550. Hood 548 has an opening 552 and may be made of cloth or any suitable material and may be connected to hood supports 530 in any manner. For example, hood supports 530 may be sewn into hood 548. Alternatively, hood 548 may have ties that connect hood 548 to hood supports 530. Alternatively, hood 548 can drape over supports 530 and attach to side walls 504, 508.

[0074] FIG. 29 illustrates waste receptacle 68 and its lid 69 in the closed condition. There is mass 271 of waste in receptacle 68, but the receptacle is not yet full. Receptacle 68 is positioned in litter box 20 for engagement with bosses 222 and 223. Bosses 222 and 223 extend inwardly from litter box side walls 22, 23, respectively, to engage indentations 63, 70 (FIG. 6). The walls of waste receptacle 68 adjacent side walls 22, 23 are provided with aligned openings 226, 227, respectively. Radiation from source 242 on wall 22 impinges upon detector 243 on wall 23 as long as the level of waste 271 in receptacle 68 does not block the radiation.

Claims

1. A litter box (20) comprising a housing (21) for receiving litter; a comb (43) disposed in said housing (21); a motor (55) for moving the comb (43) from a first position to a second position characterized by a sensor (400) for sensing contact with an obstruction.

2. The litter box (20) of Claim 1, further characterized by said sensor (400), provides a shut-off signal when said sensor (400) detects contact with a cat.

3. The litter box (20) of Claim 2, further characterized by said sensor (400), includes a switch (410) coupled to said motor (55), said switch (410) being movable between an open position and a closed position, the sensor (400) providing the shut-off signal when the switch (410) is in the closed position.

4. The litter box (20) of Claim 1, further characterized by said sensor (400), includes a leaf switch (410).

5. The litter box (20) of Claim 1 further characterized by:

   a mode selector switch (91) movable between a manual operation selecting position and an automatic operation selecting position; and

   a manual operation switch (370) electrically connected to said mode selector switch (91) for driving said comb (43) from said first position to said second position in response to actuation of said manual operation switch (370) when said mode selector switch (91) is in the manual operation selecting position.

6. The litter box (20) of Claim 5 further characterized by said manual operation switch (370) includes a foot pedal (372).

7. The litter box (20) of Claim 1 further characterized by a removable litter tray (300).

8. The litter box (20) of Claim 1 further characterized by a replaceable waste receptacle (68).

9. The litter box (20) of Claim 8 characterized by said waste receptacle (68) has a lid (69), and wherein said litter box (20) further includes means (173, 174, 176, 179) for lifting said lid (69) in response to movement of said comb (43).

10. A self-cleaning cat litter box (20) comprising a housing (21) defining a litter chamber (22, 23, 24, 25, 26) for receiving cat litter; a comb (43) disposed in said litter chamber (22, 23, 24, 25, 26); a comb drive (41, 55, 57) coupled to said housing (21), said comb drive including a drive motor (55) characterized by a sensor (400) coupled to the drive motor (55) and positioned to detect contact with an obstruction, wherein the sensor (400) generates a signal to change the state of said comb (43) in response to said contact.

11. The cat litter box (20) of Claim 10 further characterized by parallel side walls (201) for preventing debris from spilling out of the cat litter box (20).

12. The cat litter box (20) of Claim 10 further characterized by said housing (21) is provided with a removable tray (300) with rounded corners to facilitate cleaning, and wherein said litter chamber (22, 23, 24, 25, 26) has no small spaces of the type which would permit litter or waste to slip out of or become lodged in said box (20).

13. A self-cleaning cat litter box (20) including a housing (21) defining a litter chamber (22, 23, 24, 25, 26); a comb (43) disposed in said housing (21); a comb drive (55) coupled to said housing (21) characterized by a mode selector switch (91) movable between a manual operation selecting position and an automatic operation selecting position, said comb drive (55) driving said comb (43) in response to a signal from a controller (96) when said mode selector switch (91) is in the automatic operation selecting position; and

    a manual operation switch (370) electrically connected to said mode selector switch (91), said comb drive (55) driving said comb (43) in response to actuation of said manual operation switch (370) when said mode selector switch (91) is in the manual operation selecting position.

14. The self-cleaning cat litter box (20) of Claim 13, further characterized by a housing access ramp (350), pivotally connected to said housing (21).

15. The self-cleaning cat litter box (20) of Claim 13 further characterized by a tray (500) having side walls (504, 508) and a bottom wall (502) that cooperate to define a housing-receiving region (540), a plurality of hood supports (530) coupled to said tray (500), and a hood (548) coupled to said supports (530), said hood (548) having an opening (552).

16. The self-cleaning cat litter box (20) of Claim 13 further characterized by a removable litter tray (500) for receiving cat litter.

17. A cat litter apparatus (20) including a litter chamber (21) characterized by an enclosure (550) located over said litter chamber (21), said litter chamber (21) being removable from said enclosure (550).

18. The apparatus (20) of Claim 17 further characterized by a removable litter tray (500) disposed in the litter chamber (21) to receive the litter.

19. The apparatus of Claim 18 further characterized by a tray lock (330), said tray lock (330) selectively retaining the tray (500) in the litter chamber (21).

20. The apparatus of Claim 19 further characterized by the tray lock (330) rotates between a locking position and an unlocking position, said tray lock (330) interfering with the removable tray (305, 500) to retain the tray (500) in the litter chamber (21) when the lock (330) is in the locking position.

21. The apparatus of Claim 17 further characterized by:

    a comb (43) disposed in said litter chamber (21);

    a comb drive (41, 55, 57) coupled to said comb (43) and including a drive motor (55); and

    a sensor (400) coupled to said drive motor (55) and positioned to detect contact with an obstruction while said comb (43) moves between a storage position and a discharge position.

22. The apparatus (20) of Claim 21 further characterized by said sensor (400) provides a shut-off signal to said comb drive (41, 55, 57) in response to detection of the obstruction.

23. The apparatus (20) of Claim 22 further characterized by said sensor (400) includes a switch (410) electrically coupled to said drive motor (55), said switch being movable between an open position and a closed position, said switch (410) providing the shut-off signal to said comb drive (41, 55, 57) when in the closed position.

24. The apparatus of Claim 23 further characterized by said sensor (400) is a leaf switch.

25. A method of cleaning waste from a cat litter box (20) characterized by the steps of:

    operating said litter box (20) according to a manual cleaning mode (370);

    subsequently switching (91) said litter box (20) to an automatic mode configuration; and

    subsequently operating said litter box according to an automatic mode.

26. The method of Claim 25 further characterized by the step of sensing (400) an obstruction.

27. The method of Claim 25 further characterized by the step of stopping the movement of a comb (43) in response to detection (410) of an obstruction.

28. The method of Claim 27 further characterized by the step of reversing the direction of movement of the comb (43) in response to detection of said obstruction.

29. The method of Claim 25 further characterized by the step of disabling (96) operation of said litter box (20) for a predetermined period of time.

30. The method of Claim 29 further characterized by the step of actuating an over-ride system (91, 370, 372) to operate said litter box (20) during said predetermined period of time.

31. A litter box (20) comprising a housing (21) defining a litter chamber (22, 23, 24, 25, 26); a removable tray (300) for receiving cat litter, said tray (300) being located in the litter chamber (22, 23, 24, 25, 26) characterized by a comb (43) disposed in the removable tray (300).

32. The litter box (20) of Claim 31 further characterized by a lock (302, 320) for retaining the removable tray (300) in the housing (21).

33. The litter box (20) of Claim 32 further characterized by the lock (302, 320) includes a locking projection (320) coupled to the housing (21) and a locking tab (302) coupled to the removable tray (300), the locking tab (302) engaging the locking projection (320).

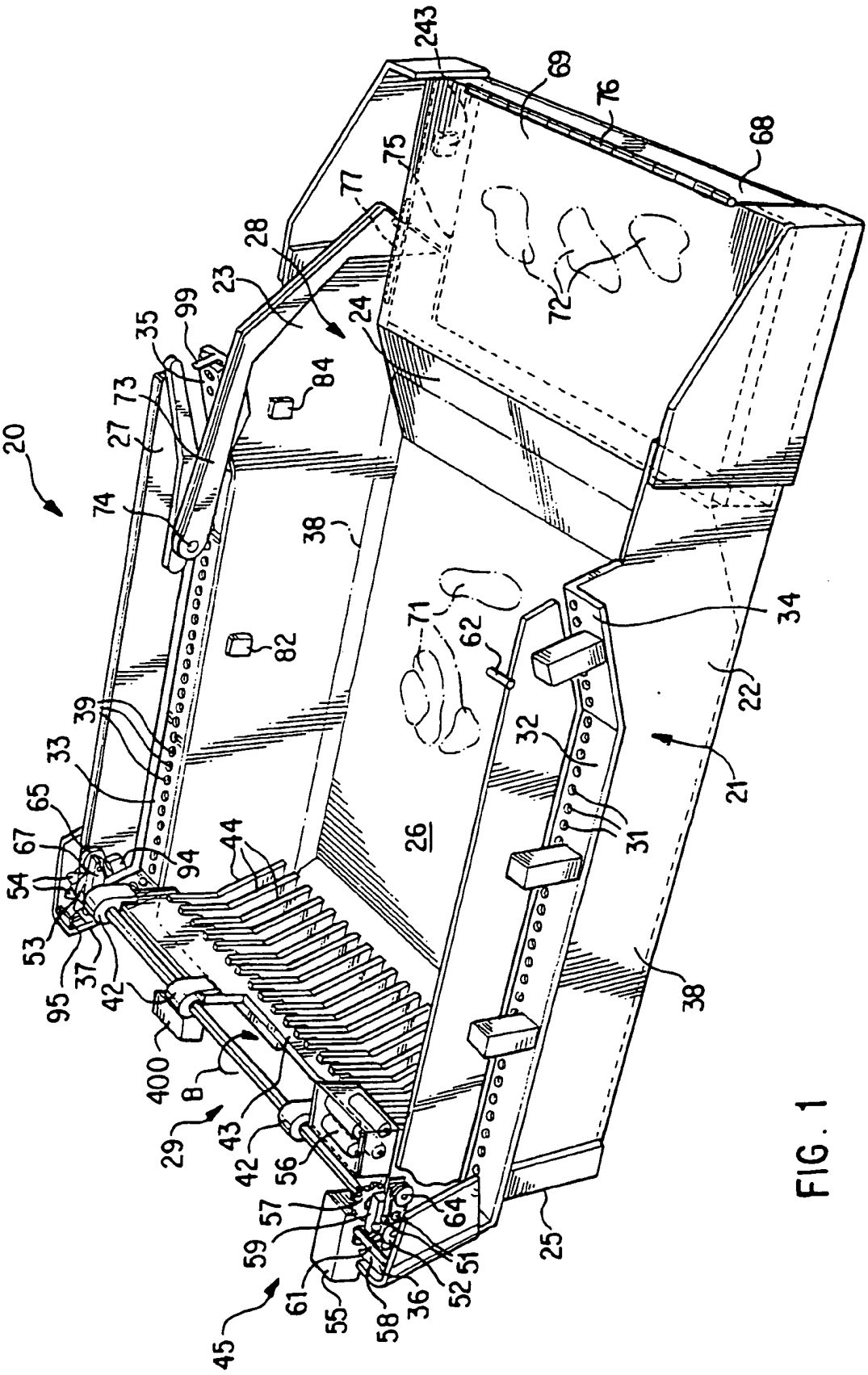
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FIG. 1

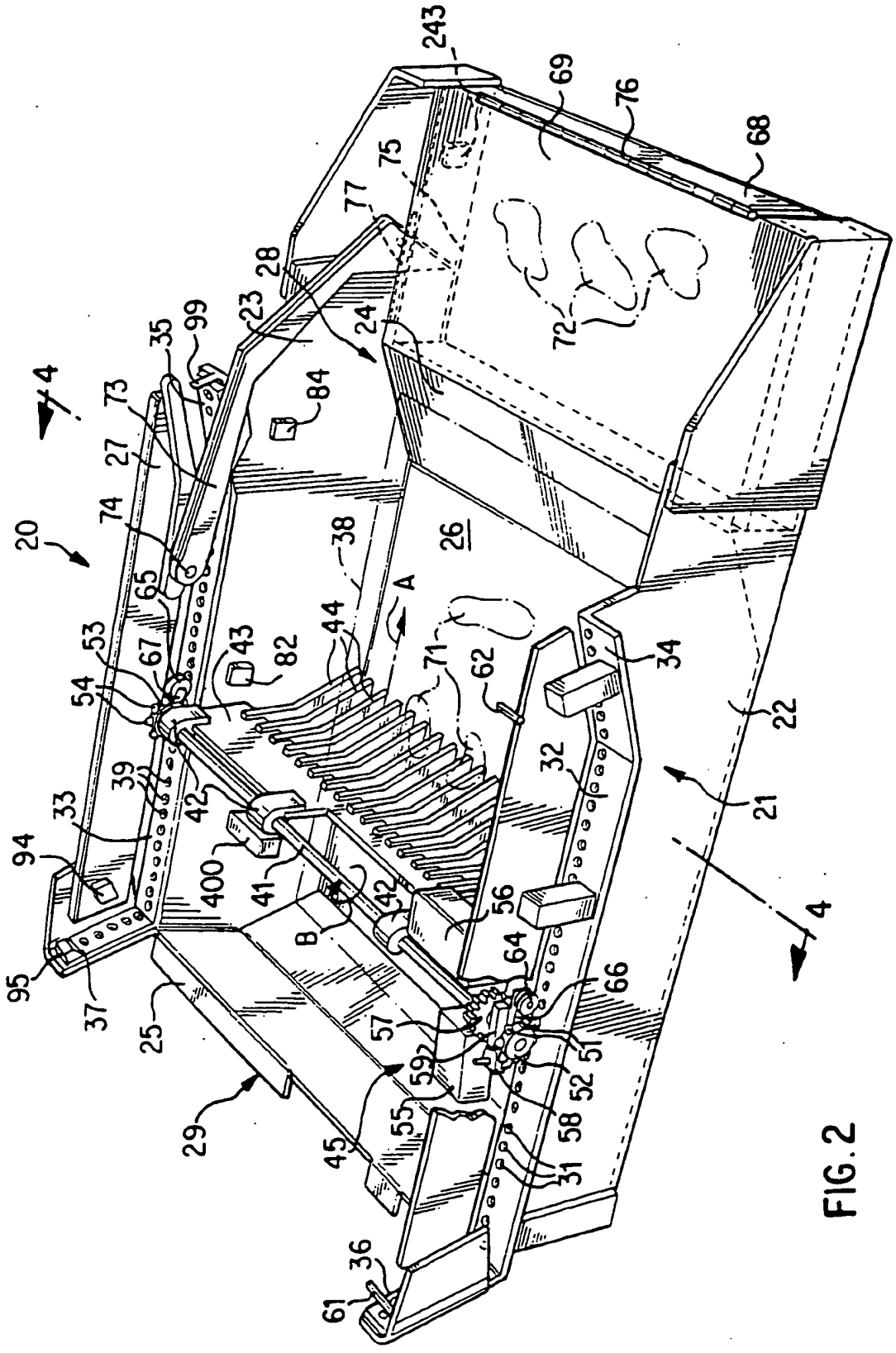
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FIG. 2

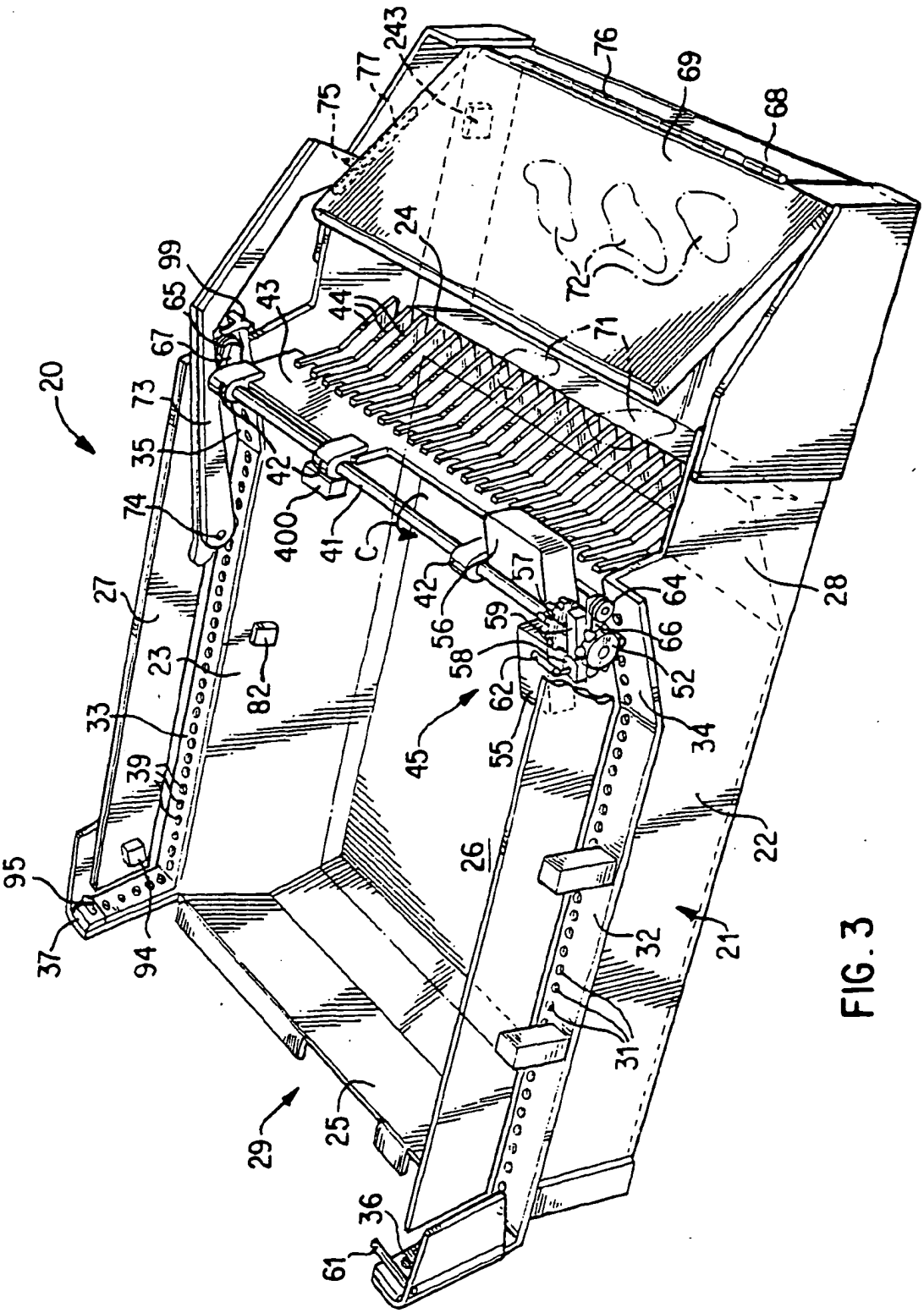
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FIG. 3

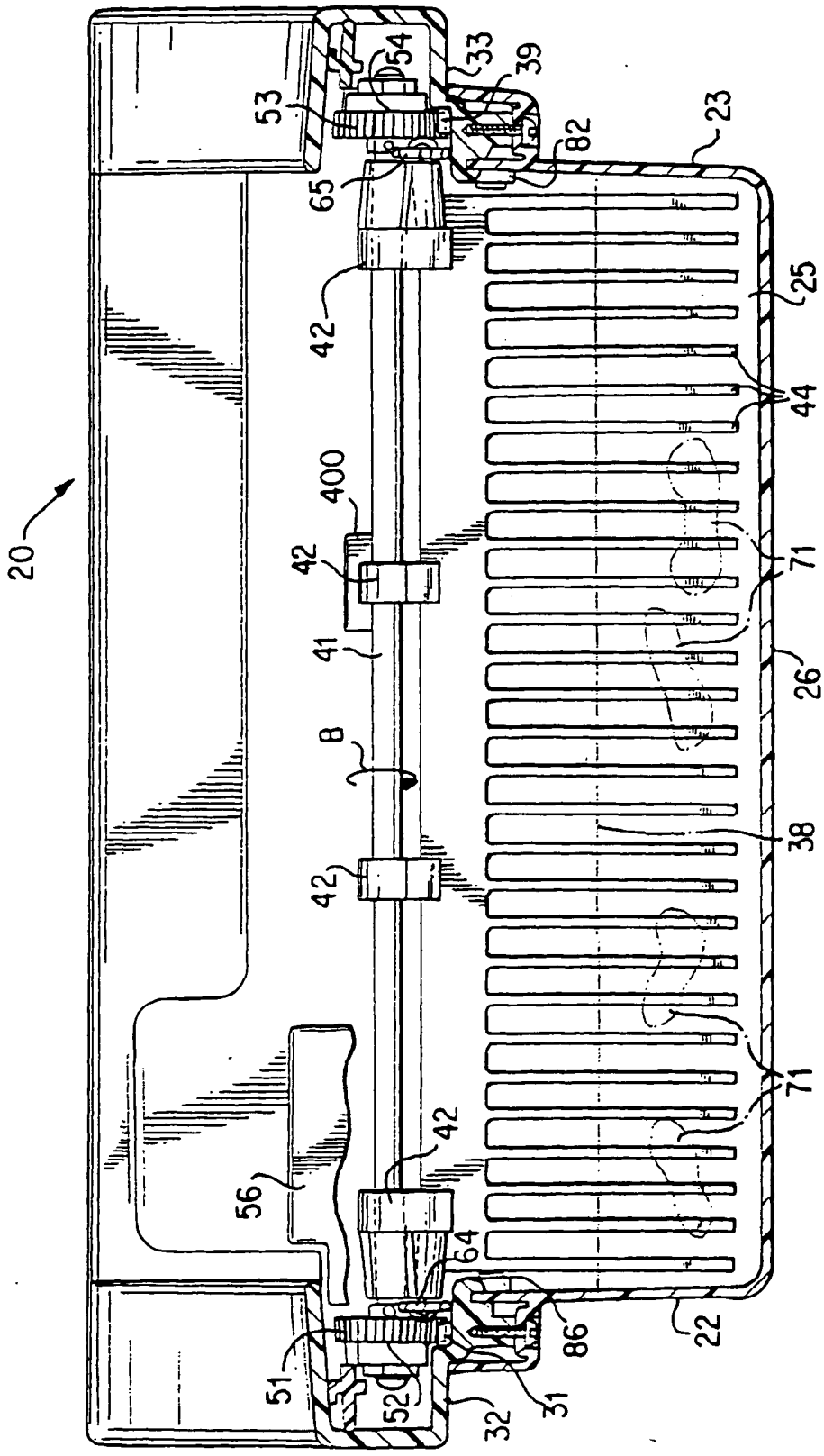
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FIG. 4

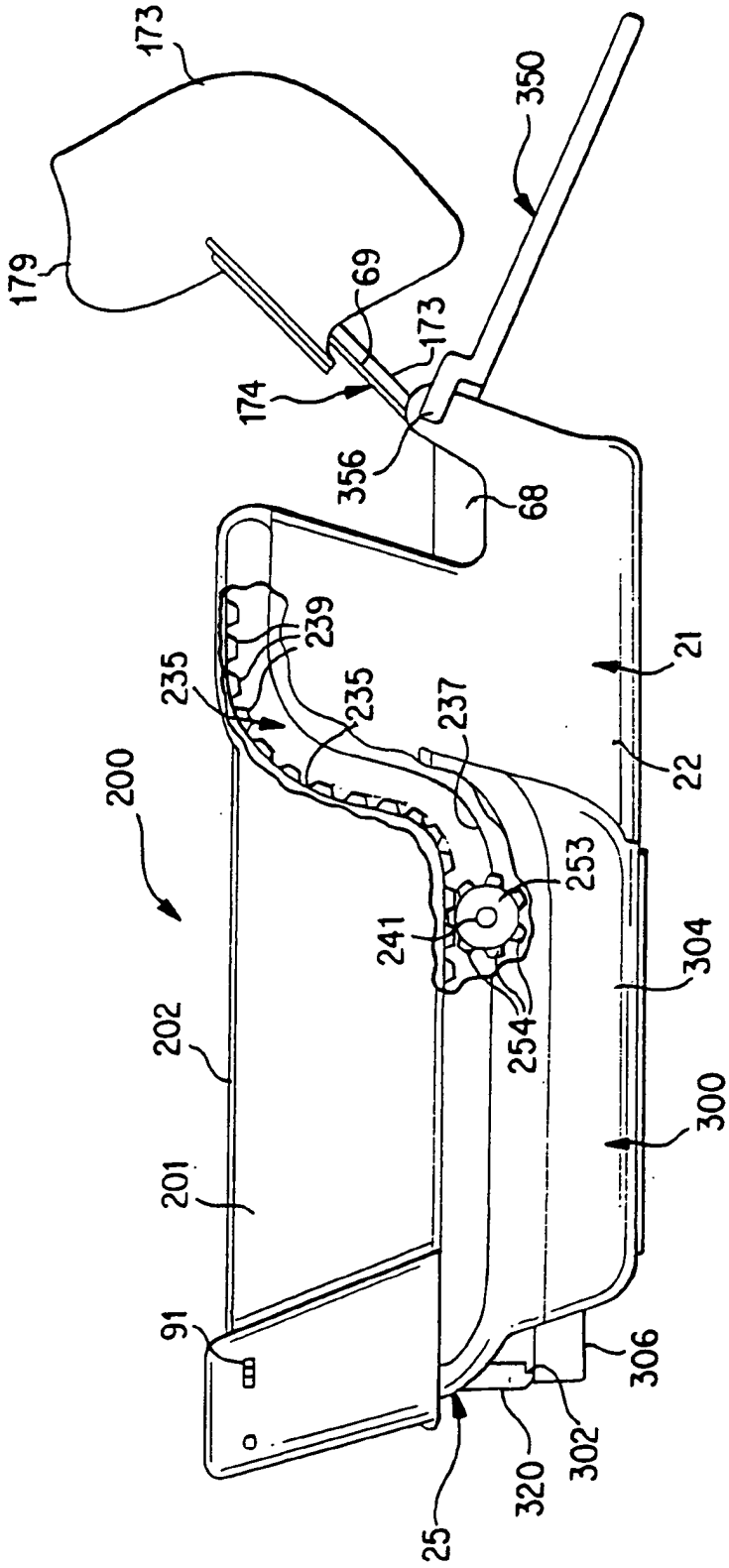
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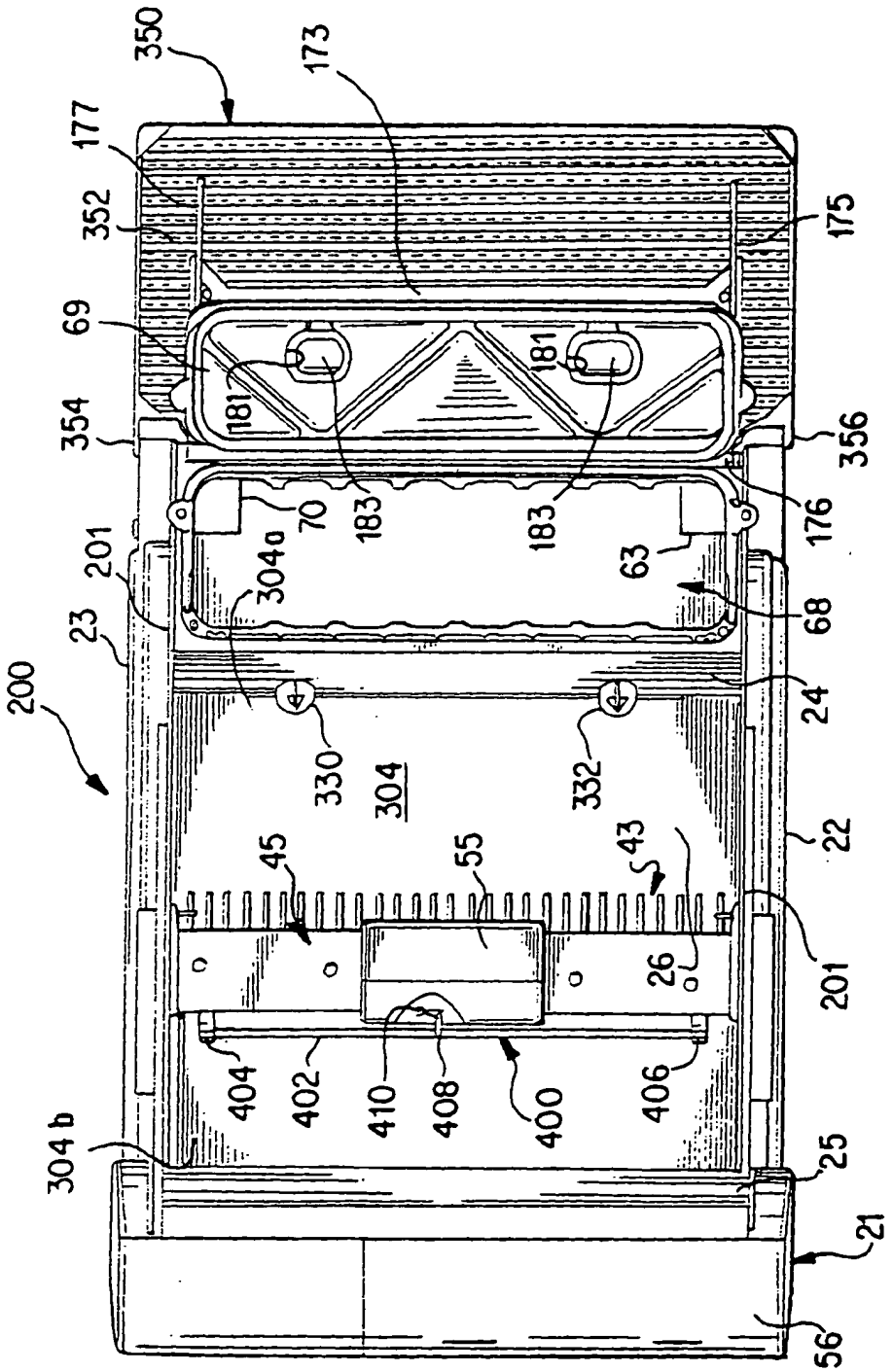
FIG. 5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304b
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FIG. 6

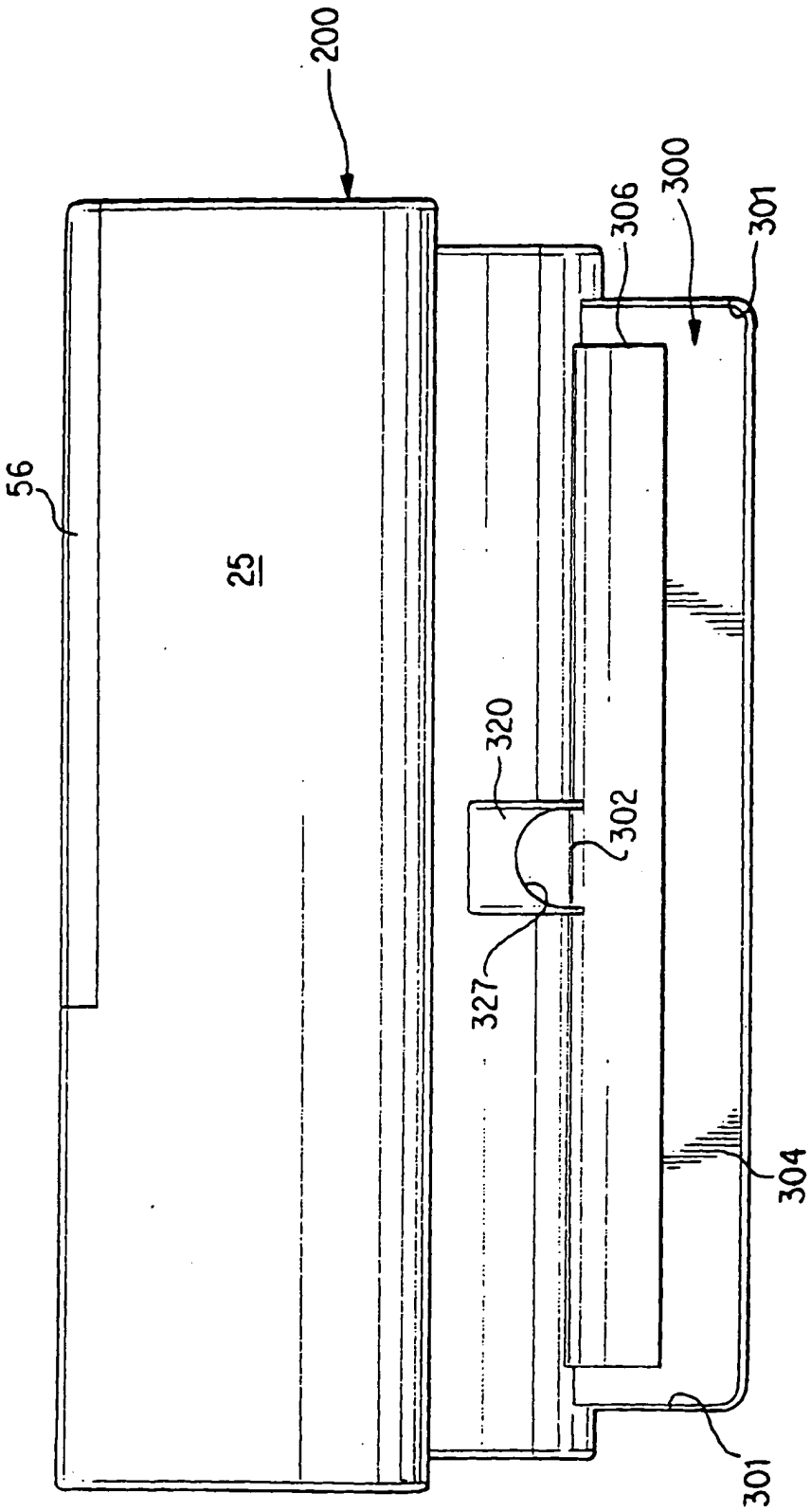


FIG. 7

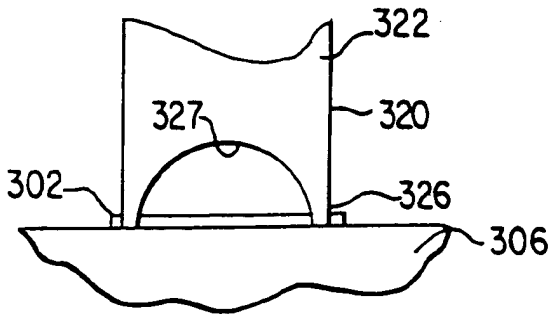


FIG. 8

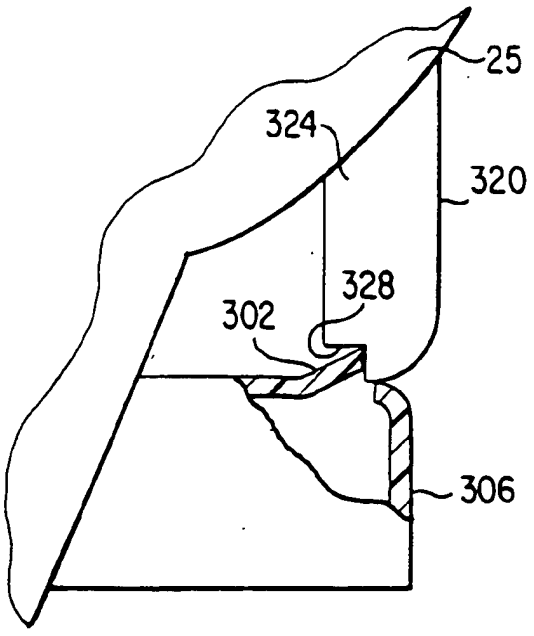


FIG. 9

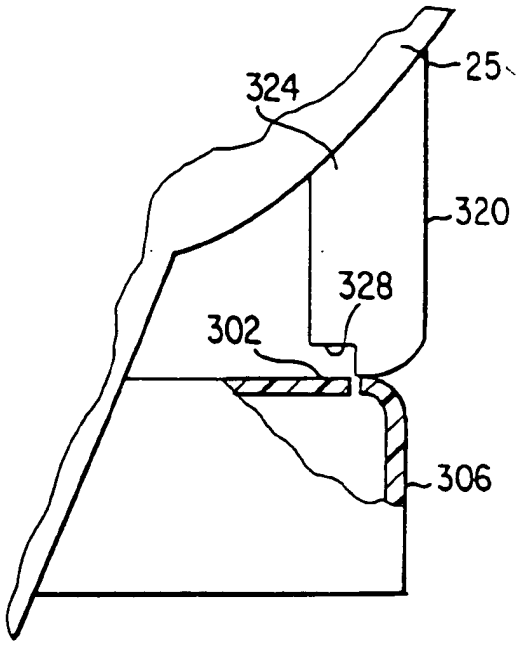


FIG. 10

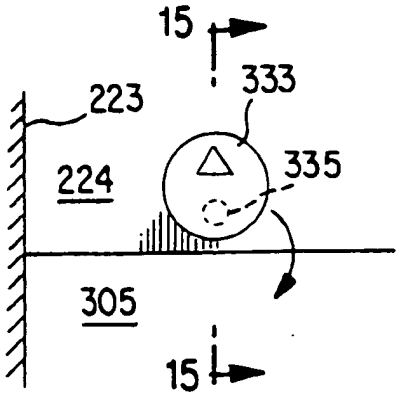


FIG. 13

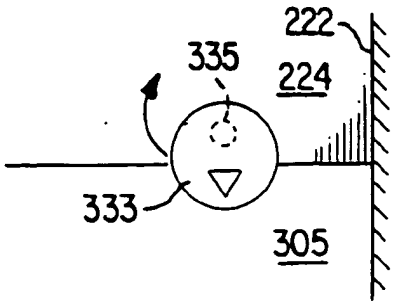


FIG. 14

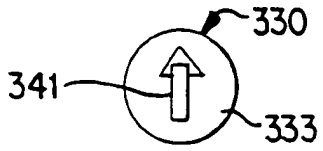


FIG. 11

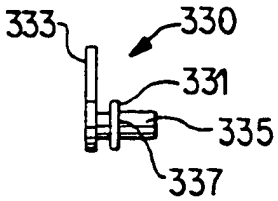


FIG. 12

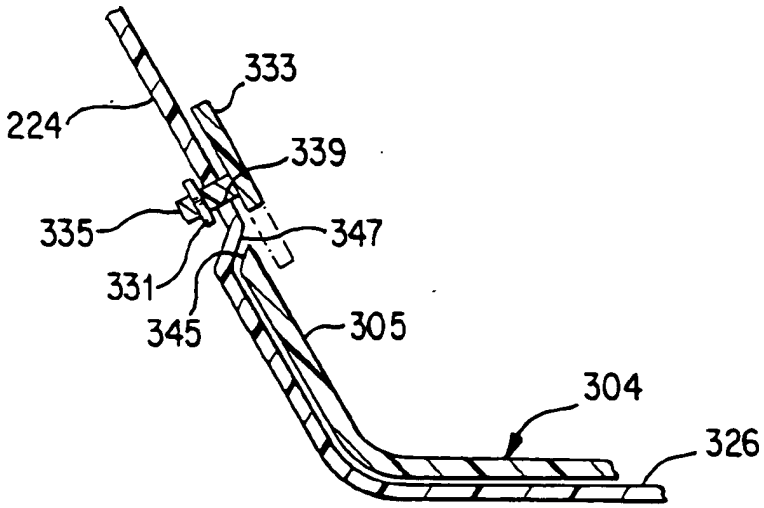


FIG. 15

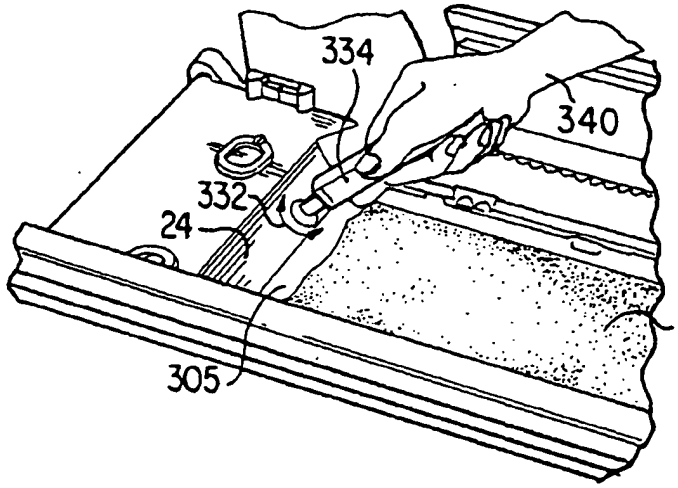


FIG. 16

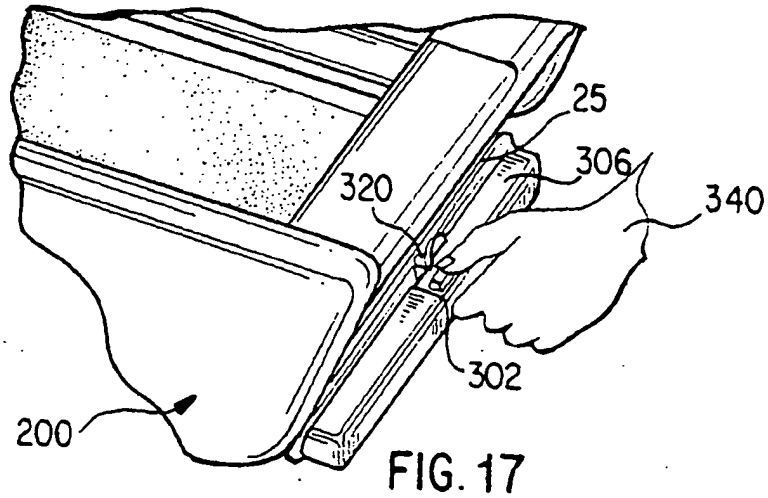


FIG. 17

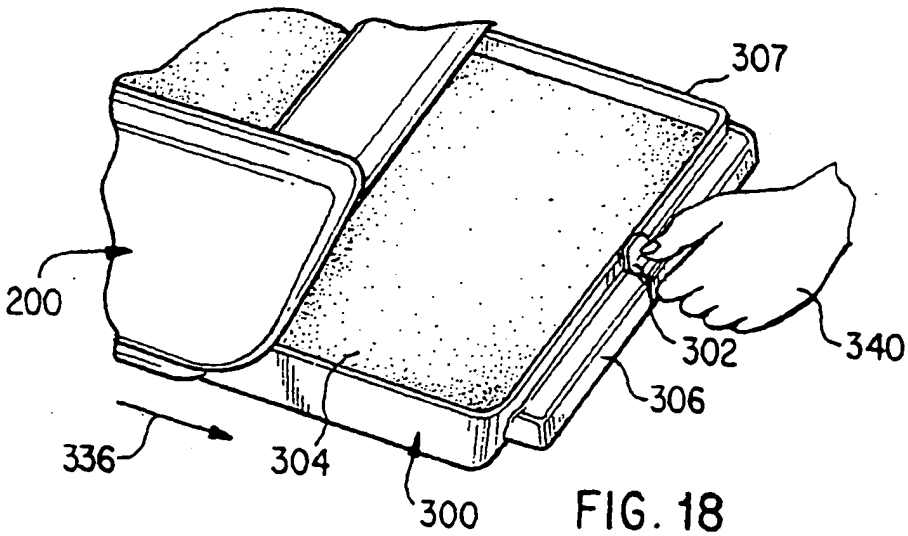


FIG. 18

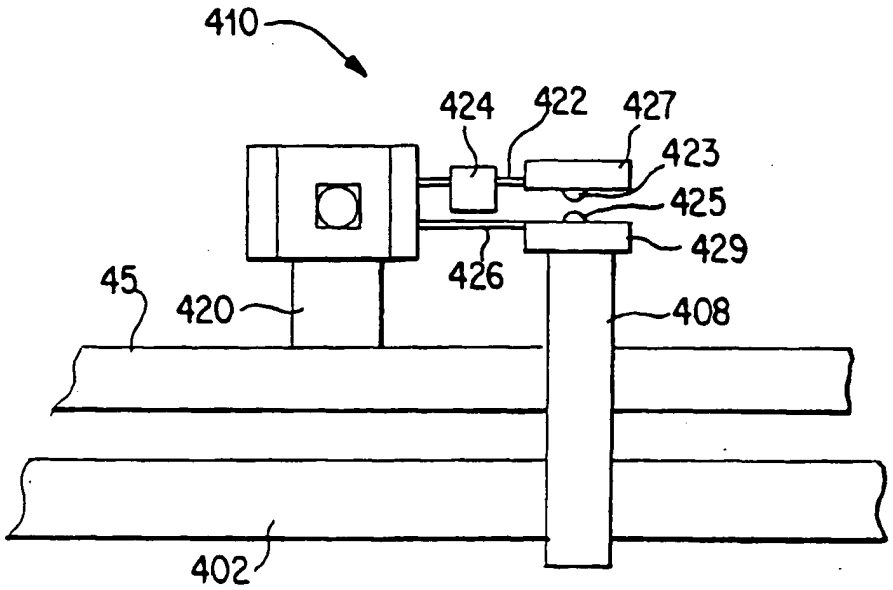
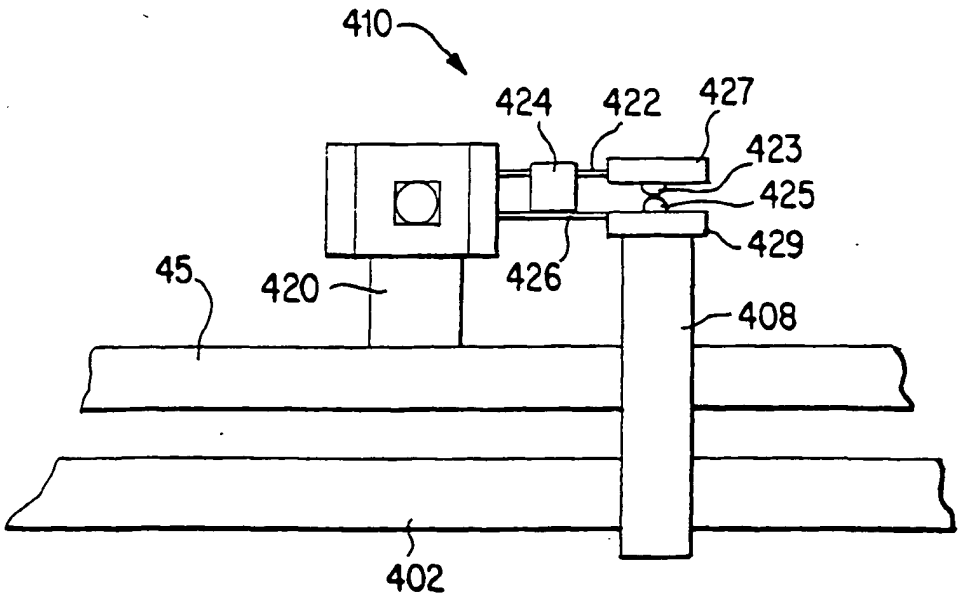

410
424
422
427
423
425
429
426
45
420
408
402

FIG. 19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420
408
402

FIG. 20

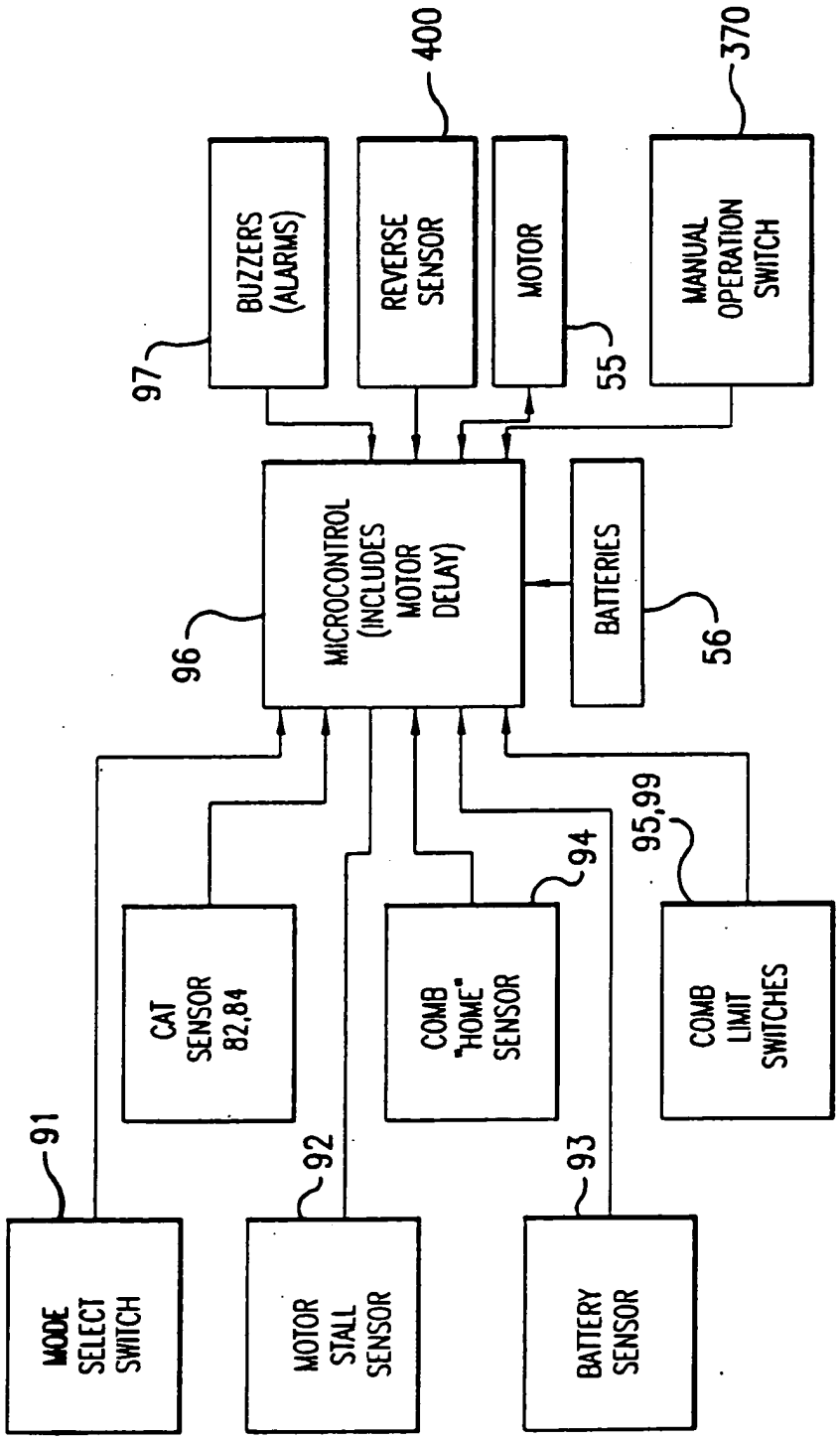
BUZZERS (ALARMS)
REVERSE SENSOR
MOTOR
MANUAL OPERATION SWITCH
400
370
97
55
MICROCONTROL (INCLUDES MOTOR DELAY)
BATTERIES
96
56
CAT SENSOR 82,84
COMB "HOME" SENSOR
COMB LIMIT SWITCHES
95,99
94
MODE SELECT SWITCH
MOTOR STALL SENSOR
BATTERY SENSOR
91
92
93

FIG. 21

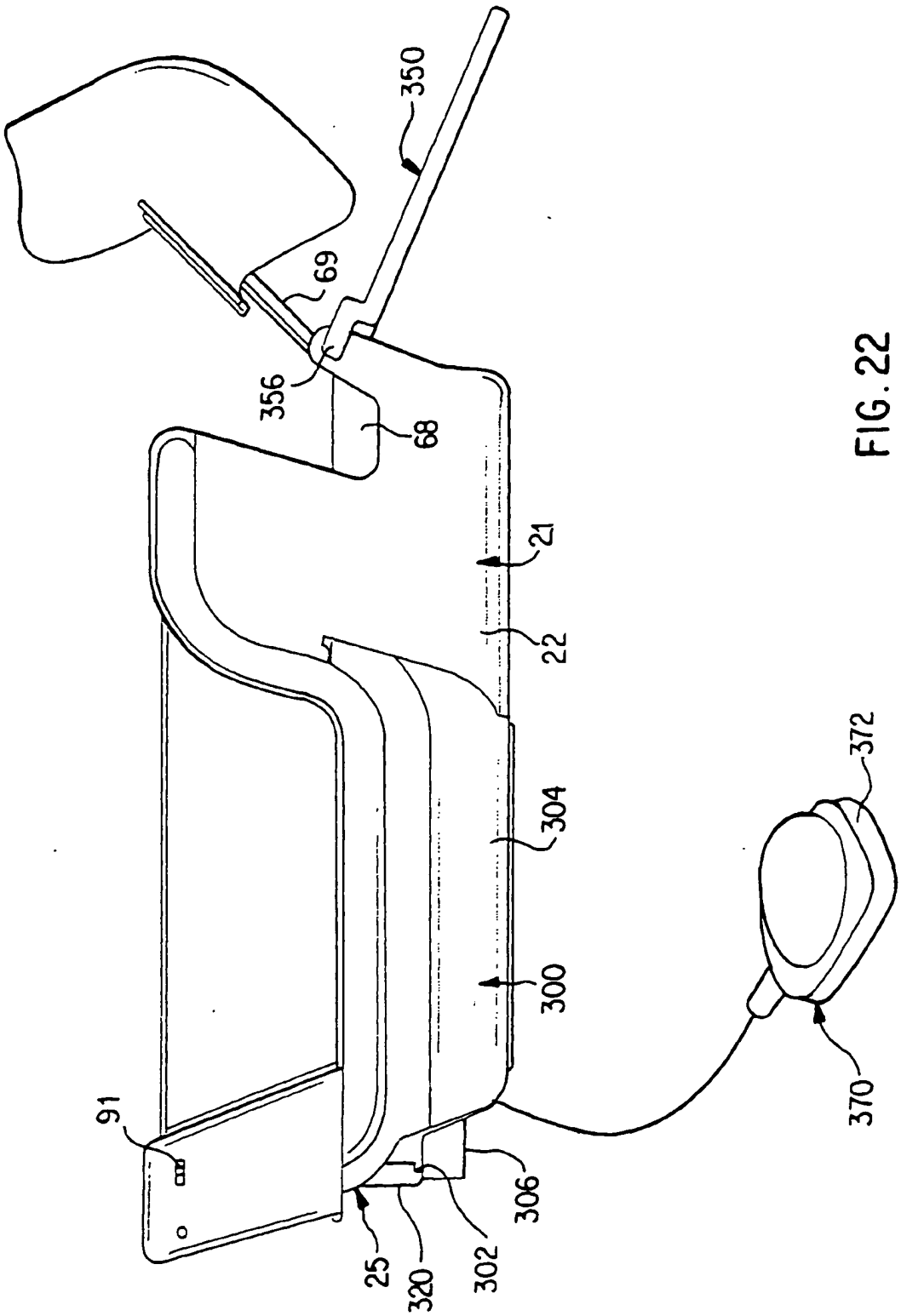

FIG. 22

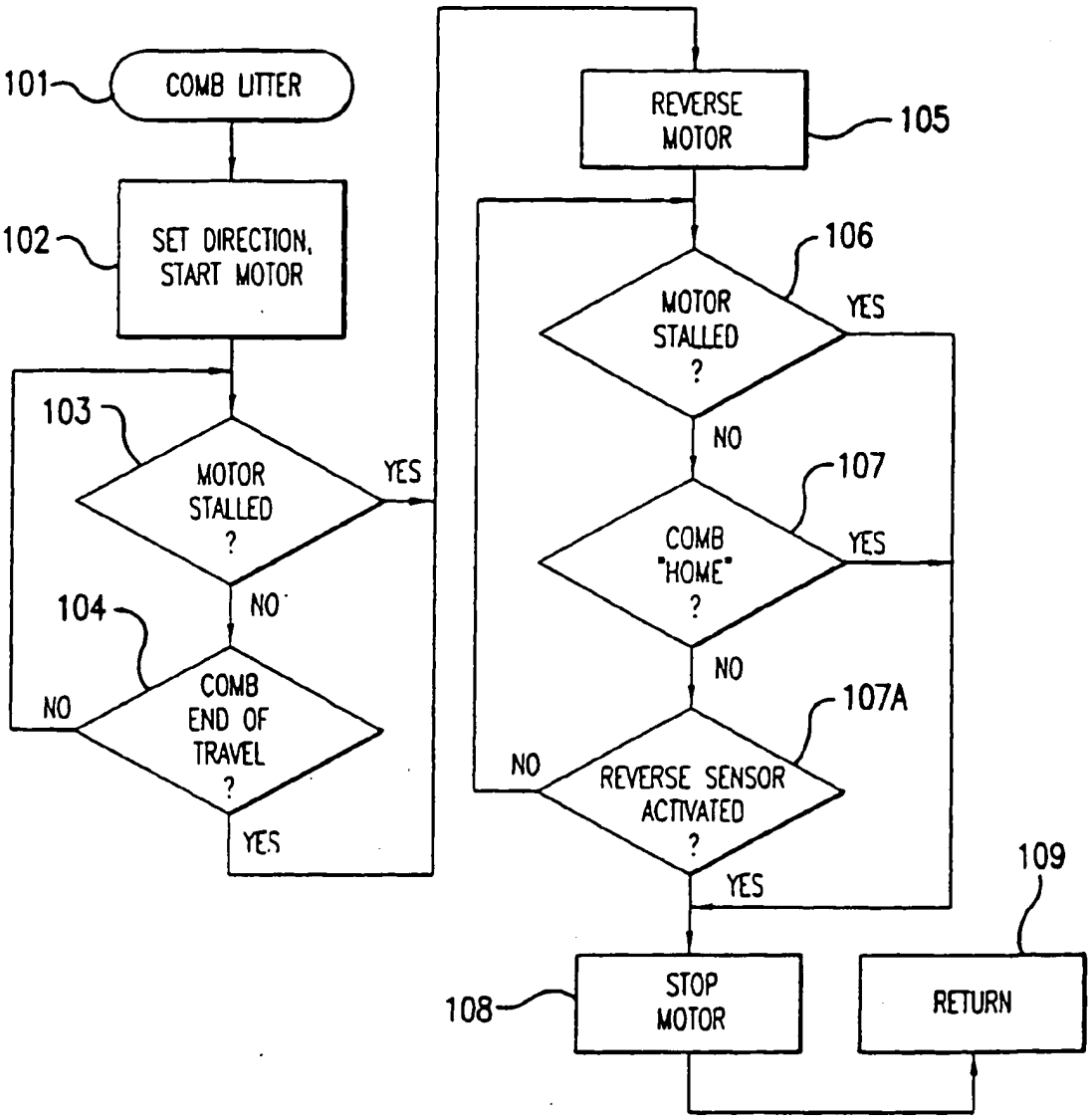
101
COMB LITTER
102
SET DIRECTION, START MOTOR
103
MOTOR STALLED ?
YES
NO
104
COMB END OF TRAVEL ?
NO
YES
REVERSE MOTOR
105
106
MOTOR STALLED ?
YES
NO
107
COMB "HOME" ?
YES
NO
107A
REVERSE SENSOR ACTIVATED ?
NO
YES
109
108
STOP MOTOR
RETURN

FIG. 23

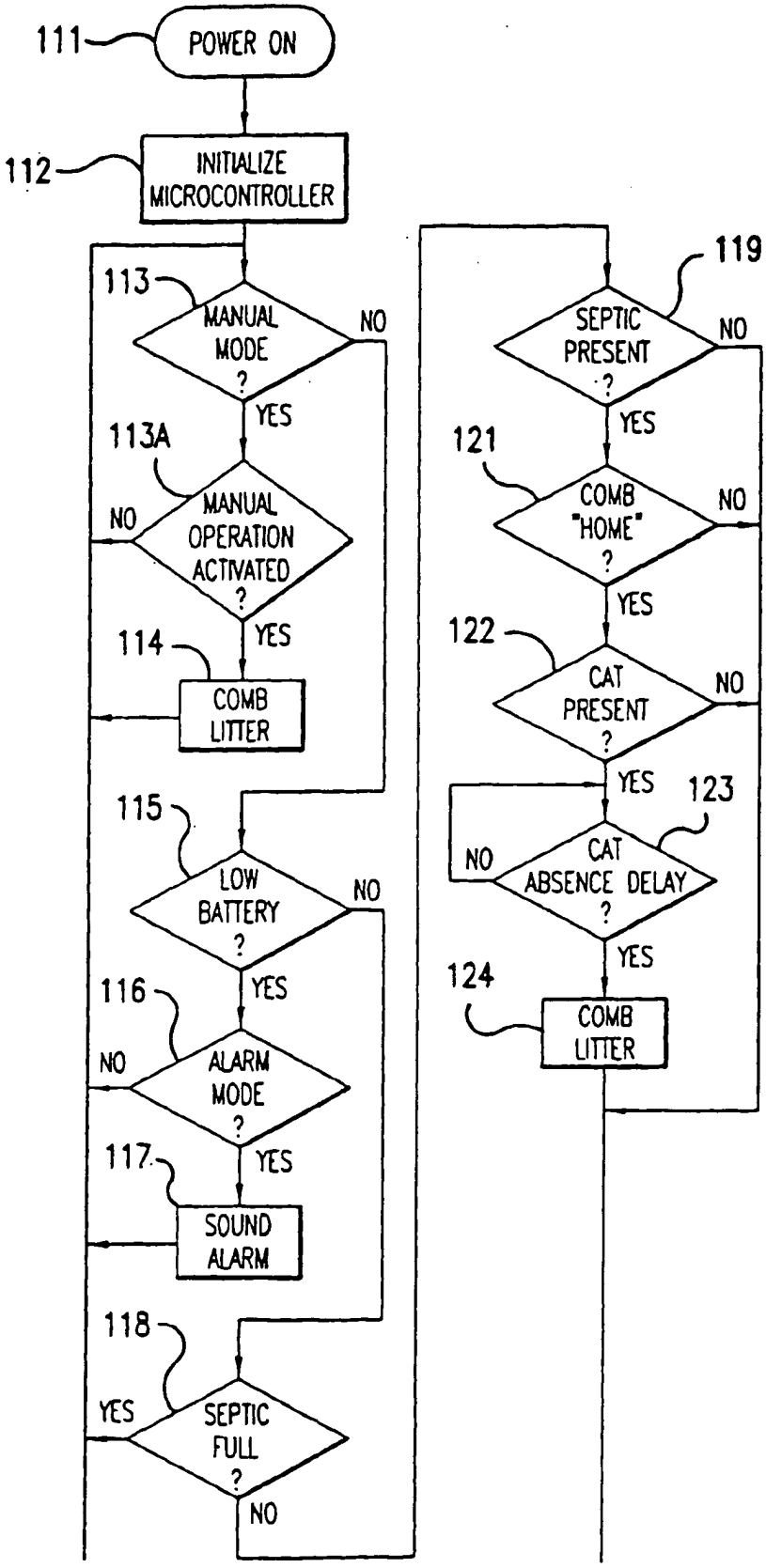
111
POWER ON
112
INITIALIZE MICROCONTROLLER
113
MANUAL MODE ?
NO
YES
113A
MANUAL OPERATION ACTIVATED ?
NO
YES
114
COMB LITTER
115
LOW BATTERY ?
NO
YES
116
ALARM MODE ?
NO
YES
117
SOUND ALARM
118
SEPTIC FULL ?
YES
NO
119
SEPTIC PRESENT ?
NO
YES
121
COMB "HOME" ?
NO
YES
122
CAT PRESENT ?
NO
YES
123
CAT ABSENCE DELAY ?
NO
YES
124
COMB LITTER

FIG. 24

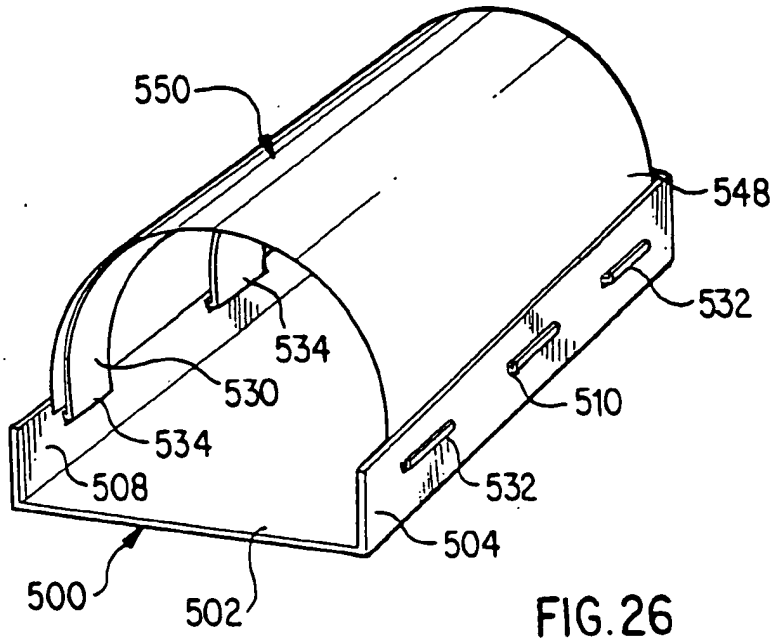
550
548
532
534
530
510
534
508
532
504
500
502

FIG. 26

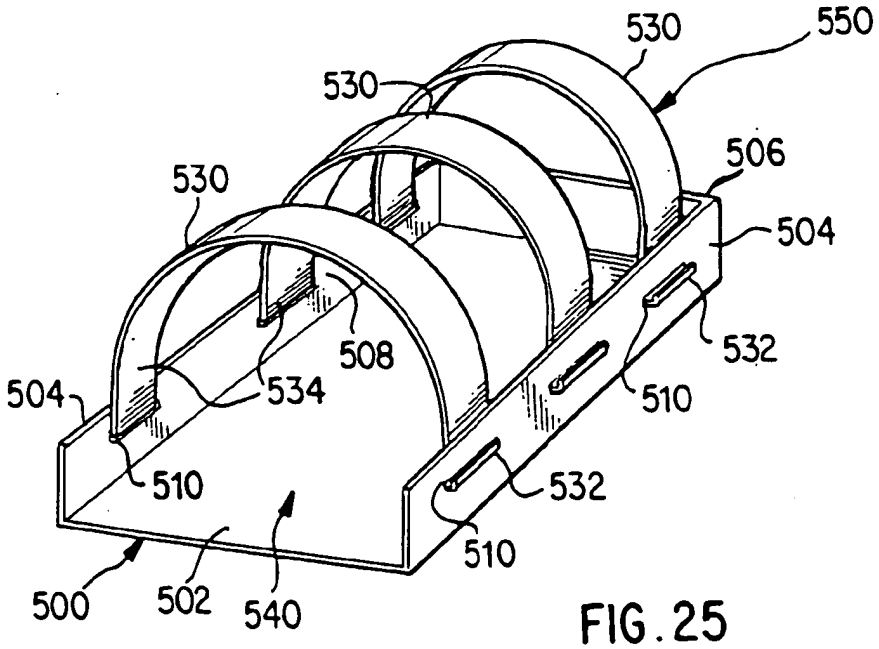
530
550
530
506
530
504
508
532
534
504
510
510
532
510
500
502
540

FIG. 25

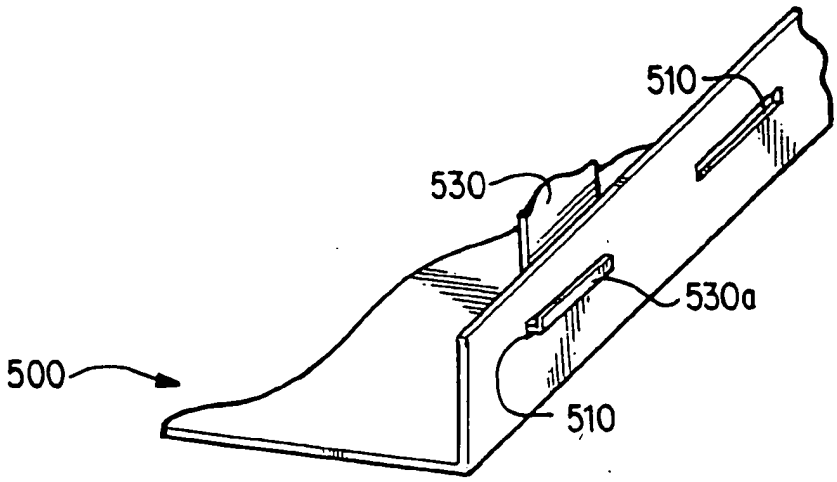
510
530
530a
500
510

FIG. 27

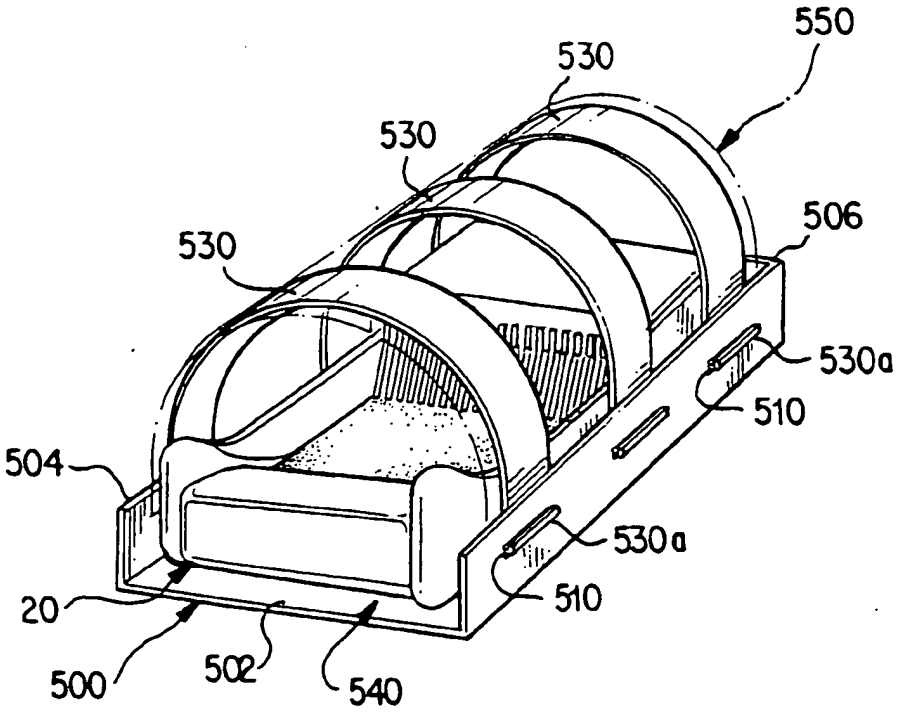
550
530
530
530
506
530a
510
504
530a
510
20
500
502
540

FIG. 28

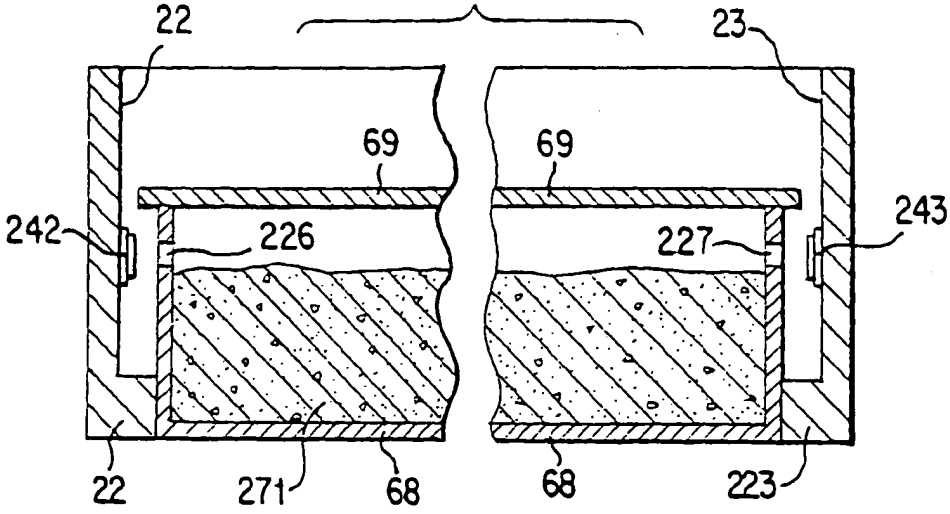

FIG. 29

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 25 0219

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X Y	US 5 107 797 A (LAROCHE JEAN-LUC) 28 April 1992 (1992-04-28) the abstract, the drawings and * column 5, line 33 - column 5, line 40 *	1,3-5, 9-33 6-8	A01K1/01 A01K1/015
Y	US 5 460 122 A (REINARTZ JOHANN O) 24 October 1995 (1995-10-24) * the whole document *	6-8	
A	US 4 897 183 A (LEWIS JR ROBERT L ET AL) 30 January 1990 (1990-01-30) * the whole document *	1-33	
A	EP 0 227 155 A (STEGGINK MARINUS GERHARDUS) 1 July 1987 (1987-07-01) * the whole document *	1-37	
A	US 4 854 267 A (MORROW DAN) 8 August 1989 (1989-08-08) * the whole document *	1-37	
X Y	DE 297 16 260 U (BECK, GÜNTHER) 2 April 1998 (1998-04-02) * page 3; claims 1,2; figure 5 *	1,3-5, 7-33 2	TECHNICAL FIELDS SEARCHED (Int.Cl.7) A01K
Y	K.HALTER: "SMA Household-Applications from Superelastic Tooth Brush to Fully Automated Cat's Toilet" 20 August 1995 (1995-08-20) , JOURNAL DE PHYSIQUE IV COLLOQUE C8 VOLUME 5 ICOMAT 95 PART II, LAUSANNE, SWITZERLAND XP002118865 * page C8-1238 - page C8-1239 *	2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	14 October 1999	Weber, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-10-1999

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